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A BALL BEARING WATER MOTOR.

H. K. CARRUTHERS.

To the Amateur Worker, power from any source, excepting foot, is his one dream. To instal a miniature steam engine is out of the question to a large number, and a gasoline engine or an electric motor are both costly. With the water pressure to be found in both large and small cities, this dream can be achieved and by simply turning on the faucet in one's own home, the power is there.

The following instructions are to tell how a motor was made, and on a 75 lb. pressure over 1/4 h. p. was easily realized. It is made of sheet zinc using three different thicknesses; 16 gauge, a thin sheet zinc or tin about 22 gauge and a thick zinc about 6 or 8 gauge. Brass or copper may be used throughout and galvanized iron for the water jacket. Sheet zinc may be purchased of hardware dealers or plumbers; sheet brass is carried only by a few hardware dealers in the larger cities, or machine shops having special uses for it. If you know of any machine shop or brass workers who have a circular saw for cutting metal, take your patterns to them and have them cut out in less than half an hour. Read the instructions over and carefully study the drawing, and you will find the making of an efficient motor not at all difficult.

First procure a bicycle hub with sprocket wheel, one which has been discarded for the coaster break style, and upon the flanges where the spokes are run through solder a piece of brass tubing the required length as at a in Fig. 1, (in this machine the tubing was 2 in. diameter by 2 3/4 in. long,) Fig. 2, shows the wheel ten inches in diameter with hole in center large enough to fit snugly over tubing on hub. The wheel has six openings, which with the metal removed, makes it easier to true up when buckets are attached. This is cut out with a hack saw from the No. 16 gauge zinc, and the little slits at a are cut 1/4 in. deep to receive the buckets. Be careful to cut them in a straight line with the point in center of wheel. After filing wheel up neat and true, solder it to tubing at b, Fig. 1. Should you find the wheel warping when applying the hot solder, true it up by soldering at different intervals wedge shaped pieces of metal shown at c, Fig. 1. I did this to mine and it makes a very strong job.

The two brackets or supports for hub and wheel are cut from the heavy metal and are made to size, as in Fig. 3. At a is shown the position where braces, Fig. 4, are soldered. The four braces, Fig. 4, may now be cut and soldered in place.

The base is made from the heavy metal and is 14 1/2 in. long by 8 1/2 in. wide. An opening is cut in center 5 in. long by 1 3/4 in. wide, Fig. 5. Around the opening at a is soldered a flange from thin zinc about 2 in. dep. This is the outlet for the waste water. Fig. 6 is a diagram of the base showing the exact position for the supports, water outlet, and lower half of water jacket.

The water jacket can now be made for the lower half. Cut two pieces from the heavy metal 2 x 6 1/4 in., and for the sides two pieces from the thin zinc 13 1/4 x 7 1/4 in., Fig. 7. The dotted lines at a are 1/2 in. from edges and this portion is bent to an angle of 45°; b is a half circle cut out for hub to set into. These sides are soldered to the edges of the 2 in. strips just cut, and to make a neat job of it try the scheme, shown in section in Fig. 8; a shows where the solder is run in. When finished, file and sand paper off any roughness and lay on base in position as indicated by dotted lines, Fig. 6. The lower flange is soldered securely to base and will appear as at a Fig. 9. The supports can now be soldered on to position shown on diagram, Fig. 6.

Set the wheel in place now and adjust the cones, then tighten the nuts. This will afford a good opportunity to fasten the buckets in place. Take a strip of the zinc 3/4 in. wide and about 24 in. long and cut from this 24 pieces 7/8 in. long. Bend on dotted lines, Fig. 10, to the angle shown at a. When all are bent press into the slits at a, Fig. 2, and solder, taking care to distribute solder evenly so as to insure an even balance. The work done so far will look like Fig. 9, excepting for the nozzle shown.

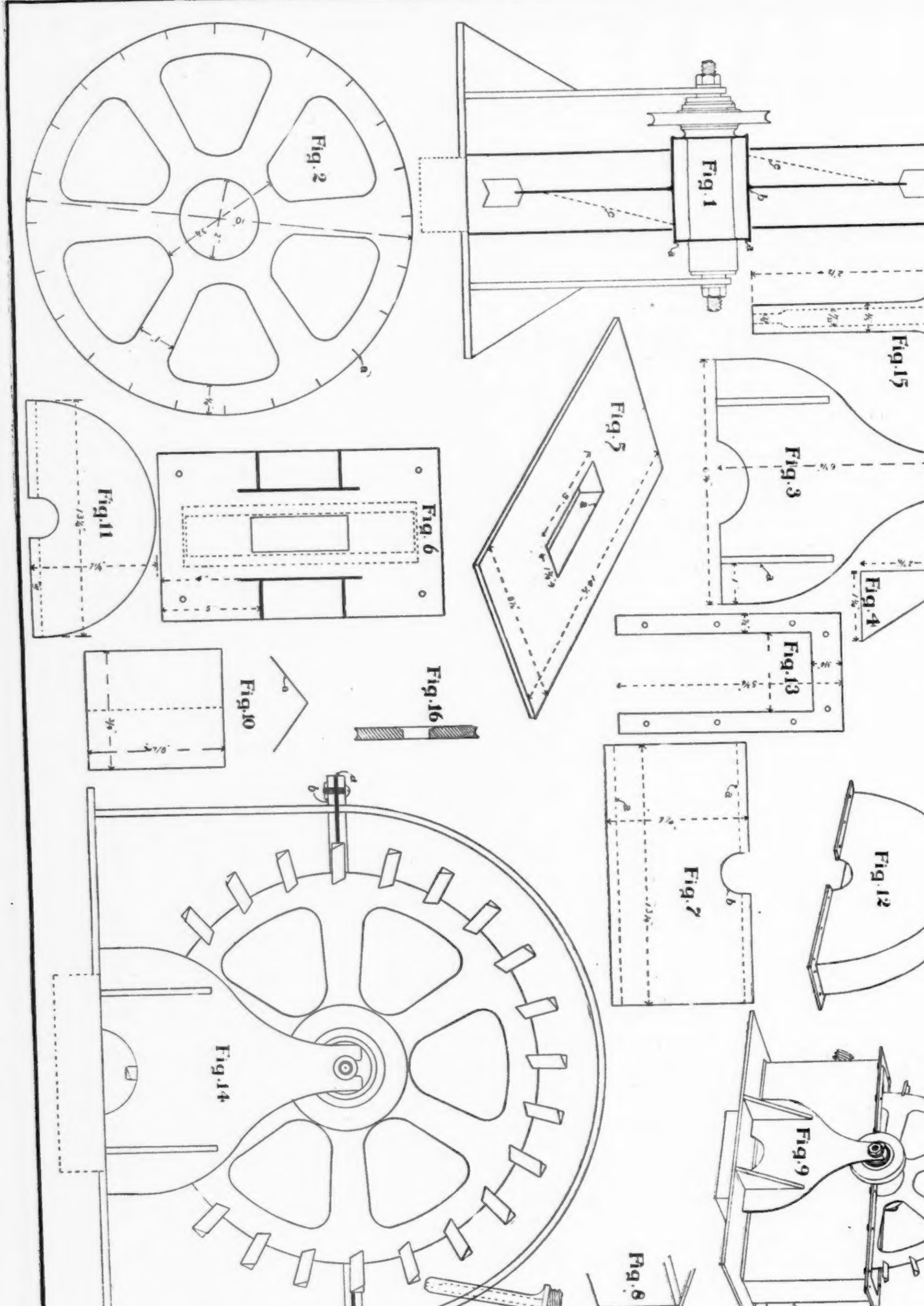


Fig. 1
Fig. 2
Fig. 3
Fig. 4
Fig. 5
Fig. 6
Fig. 7
Fig. 8
Fig. 9
Fig. 10
Fig. 11
Fig. 12
Fig. 13
Fig. 14
Fig. 15
Fig. 16

The top half of water jacket in which the nozzle is located is made by cutting two pieces of thin zinc shown in Fig. 11. Next take a strip of the heavy metal 2 in. wide and long enough to go round the half circle and have a tinsmith bend it for you to proper shape. Solder sides to this similar as described in Fig. 8, when finished will look like Fig. 12. Cut from the heavy metal 4 pieces the size given in Fig. 13, and drill holes as marked. Two of these are soldered on flanges in Fig. 12 and under the flanges in Fig. 9. This helps to stiffen the sides and keep the holes in line with one another . Clamp two of the pieces together when drilling, thus insuring the holes being in line, when top half of water jacket is placed on lower half. Use 5/8 in. stove bolts. From the same pattern, Fig. 13, cut two pieces of thick sheet rubber and lay between flanges as shown at a, Fig. 14. Punch holes to correspond with metal pieces.

For the nozzle, Fig. 15, you can have a machinist make it or you can make it yourself. Buy a 10 cent hose connection and use the male part. Make a paper cone 1 in. long to fit on shank, plugging the end, pour in from the threaded end hot solder and when set take off paper, and have it drilled similar to Fig. 15.

The sprocket wheel can be used with a chain belt but prefer a wooden wheel, and a cross section of it is shown in Fig. 16.

This will complete the making of your motor and all that remains to do is to give it a couple of coats of a good dark machine enamel, both inside and outside. This prevents any rust taking place.

PRODUCTION OF PLATINUM.

F. W. HORTON.

The year 1905 saw a phenomenal rise in the price of platinum and a greatly increased production in the United States. Early in March, 1905, the price of ingot platinum advanced from $19.50 per ounce to $21, surpassing gold in value. On April 1, 1905, the price fell to $20.50, and remained firm at this quotation until February 1, 1906, when it jumped to $25, where it remained until September 1, when it leaped to the unprecedented value of $34. The production of platinum in the United States increased from 200 ounces in 1904 to 318 ounces in 1905.

The rise in the price of platinum and its increased production in this country may be ascribed to two causes: the growing demand for the metal and the reduced yield of the Russian placers, which usually furnish about 90 per cent. of the world's supply.

The anxiety felt by the platinum dealers during the Japanest-Russian war has not abated since the settlement of international difficulties, but has, rather, increased as Russia's internal dissensions have developed. Even before the uprisings, it is said, the large Russian mines were purposely curtailing their production. This reduction of the output is due to the fact that the entire product for a varying term of years was brought up under contract and at prices that now seem ridiculously low. As the mine owners receive only the fixed price, they do not participate in any gain due to rise in value, and are therefore not desirous of a large production, but are husbanding the limited resources of their mines until such time as they can dispose of their produce to better advantage. Meanwhile the small mines, which, generally speaking, are not hampered by such agreements, are working to their full capacity, to take advantage of the stimulated prices; but their entire output is only a small percentage of what is usually produced. A greatly increased consumption of platinum in the electrical and chemical industries, together with this stringency of supply, accounts for the prevailing high prices.

The exhaustive tests and examinations of black sands commenced early in 1905 in connection with the Lewis & Clark exposition, and still being carried on at Portland, Oregon, by the United States Geological Survey, have done much toward placing platinum mining in this country upon a stable footing and developing it into a permanent and profitable industry. Not only have many discoveries of platinum in new localities been made, but the tests have revealed the fact that there are districts which contain surprising quantities of platinum, and they have also given much valuable data as to the best method of obtaining it.

The promising fields are in the counties of southern Oregon and northern California. Here the metal has been found in commercial quantities. With proper methods a considerable annual output should be obtained. The platinum metals are usually found in working gold placers, especially where the gravels are derived from peridotites. Many managers of placer mines have been convinced for a long time that it would pay to save the platinum in the gravels, if it could be done by some inexpensive method. The experiments of the United States Geological Survey which were conducted under the supervision of Dr. David T. Day have shown conclusively that 95 to 98 per cent. of the precious metals, both gold and platinum, contained in the sluice box sands can be saved on concentrating tables such as are used in everyday practice; and that in most cases the concentrates thus obtained will represent less than one per cent. of the total weight of sand fed to the table.

It should be noted that the imports of platinum during 1905 were valued at $2,173,263, as against $1,879,155 in 1904, an increase of $294,107. Considering the increased demand for platinum, the gain in importation is slight, but if the high price and scarcity of the metal be taken into account, the wonder is that there was not a large decrease in the quantity imported.—"The Mining World."

New Zealand has 2,374 miles of railroad in an area of 104,000 square miles.

TRANSFORMER FOR EXPERIMENTAL WORK.

PROF. W. G. CLARKE.

At the present day nearly every experimenter has the alternating electric current in h s laboratoiy or else has easy access to a reasonable amount of supply. The voltage is usually either 104 or 52, and the fiequency is usually 60 cycles.

It frequently happens that in your work you will need voltages both away below and away above this fixed amount. You can easily get a lower voltage by inserting an adjustable rheostat in the circuit in series with your work. With this, however, you cannot get a higher voltage than the source of supply, and unless you have a voltmeter you can only guess at the amount of voltage that you are actually using.

By the use of an auto transformer you can get a range of voltage from 5 to 500 in steps of 5 volts and you know very close to the amount of voltage that you are using.

An auto transformer is not difficult to construct and the possessor of one will find no end of comfort and convenience in its use.

First procure a sheet of electrical steel 24x96 inches and .014 thick. Go to at tin shop and with the foot power squaring shears have them cut across the sheet, 8 pieces each 7 1/8 inches long, and another 8 pieces each 3 5/8 inches long. Then cut across these 16 pieces making a large number of pieces each 1 1/8 inches wide, and you will find that you will have 168 pieces 1 1/8 by 7 1/8, and 168 pieces 1 1/8 by 3 5/8. This is somewhat more than you need but it is well to have a few over as some are almost sure to be bent out of shape so that they cannot be properly straightened without a great deal of trouble.

The greatest care must be taken in setting the guages on the shears so that all the pieces will be exactly the same width at each end and also that they are cut perfectly square. Otherwise your transformer core will look anything but symmetrical although it will perhaps do the work just as well.

If you cannot get the electrical steel in your town we can tell you where to get it and also where to get it cut up ready for assembling in case you cannot find a squaring shears handy, but this last is unlikely as nearly every small tinshop has to have a foot power squaring shears.

Sheet tin or any kind of very soft iron will answer the purpose only that you will require a much larger number of pieces in order to get the required thickness of core.

Make up 16 lots of each length of pieces, each lot to have an equal number of pieces and this number to be such that when 8 of the lots are clamped together tightly in a vise the whole will measure just 1 1/8 inches in thickness.

Build up your core by laying the several lots of pieces down on a board in the position shown in Fig. 1, and with the corners interlocked as the diagram clearly shows.

Now procure about a dozen small malleable iron clamps and clamp the whole core together tightly and evenly, tapping the corner edges with a hammer until all is square and symmetrical. If you have done your cutting and have used due care in assembling the pieces you should now have a very presentable core indeed, in fact some of these cores made up by amateurs are fully as god in every way as the cores made in the large factories with expensive automatic machinery.

Take your core on the board to a machine shop where there is either a drill press or a good lathe and drill 8 holes through the core with a 3/16 inch twist drill at the points shown in the diagram. A piece of hard wood should be placed under the core at the point where the drilling is being done so that it will receive the point of the drill when it comes through and thus prevent the formation of much "burr" at this point. A clamp should also be on each side of drill and as close to the hole as possible, the clamps can of course be moved around, one at a time, as the drilling progresses, care being taken however, to at all times have enough clamps on the core so that the pieces are tightly clamped all around.

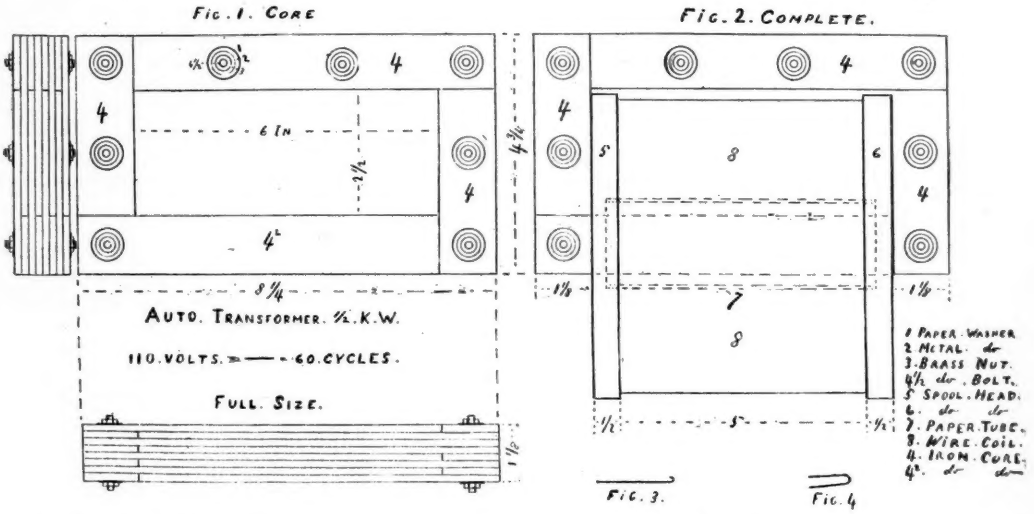
Cut off 8 pieces of brass rod 1 3/4 inches long and No. 8 screw size in diameter. On each end of these pieces cut a No. 8/32 thread for a distance of about half an inch. Now procure 16 hexagon brass nuts No. 8/32, 16 brass or copper washers that will just go over your bolts, and 16 fiber or paper washers that will also just go over the bolts, but about 1/4 inch diameter. You can cut these paper washers out of cardboard.

Cut some strips of typewriter paper 1 1/8 inch wide and paste one turn of this around each bolt so as to insulate the bolt from the iron core. Now place the bolts carefully in the holes in the core, put a paper washer on each end, then a metal washer, and then the nuts. After all the bolts are in place you can screw up carefully with small bicycle wrenches until the core is tight all over and then you can remove the clamps. You will see the position of the washers and nuts by referring to 1, 2 and) in Fig. 1.

Make a wooden roller carefully turned up to 1 3/4 inch diameter throughout its entire length of 8 inches. Cut a number of strips of cardboard 5 1/2 inches wide

and the whole length of the sheet. Soak the cardboard in water and carefully remove one piece at a time and wind it on the wooden roller fastening it together with ordinary flour paste. Be careful, however, not to get any of the paste between the cardboard and the roller. Dry the tube out thoroughly either in the air or in a slow oven and then drive out the roller and you should have a very solid paper tube 1 3/4 inside and 1/16 of an inch thick. Trim off the ends with a sharp knife so that they are square with the sides of the tube and so that the tube will be not less than 5 3/8 and not more than 5 1/2 inches long.

Drill a hole in one of the heads close to the tube and pass the end of your wire through for about 6 inches. Cover the tube with one layer of the Grimshaw tape and wind on a layer of the wire allowing it to pass under a round brass bar placed close to the spool so that by holding the wire with the hand at the proper angle, it will wind on under great tension and consequently very tight. With care you should get about 90 turns of wire on each layer. Give each layer a good coat of thin shellac varnish as soon as wound and when this is good and hard put on a turn of cotton or linen cloth, fastening it at the edge with flour paste and seeing that it is pulled tightly in



Make two spool heads of perfectly dry hard wood as shown at 5 and 6, Fig. 2. Cut a square hole in the center of each of these so that they will fit tightly over side 4² of the core after it has been covered tightly with a layer of Grimshaw tape, which, by the way, should be put on this leg before the clamps are removed, the clamps can be removed one at a time as the taping progresses. The other three legs of the core are of course left untaped.

In each of the spool heads turn out a round recess 1/4 of an inch deep and of such a diameter that the paper tube 7 will just push tightly into the recess. Now put some thick shellac varnish on the tube ends and push the two heads on, see that they are square with the tube and allow the shellac to dry over night.

Procure about 25 pounds of number 16 B. & S. gauge single cotton covered magnet wire. Mount your spool on a square bar of wod in the lathe and arrange back gear so that the spool will turn very slowly. Wind a bunch of tape on the wooden ber and up against the outside of each spool head so that the heads will not be pushed off of the tube as the wire is wound on.

place. Now wind another layer of wire and so on until you have wound just exactly 600 turns. Now bare your wire for a 1/2-inch and solder on a piece of thin brass or copper about 1/4 inch wide and about 2 1/2 inches long and bent to receive the wire as shown in Fig. 3. Take a piece of the tape about 2 inches long and place it under where this tap lies down on the coil, so that when the sides of the piece of tape are bent upwards and over they will cover the soldered joint and also the wire for about an inch on each side of it. Wind on another 600 turns and when you are pasing the first tap be sure and put a piece of tape on with its end under the turn of wire nearest to the piece of brass or copper. Do this on each side of the tap and leave the tape long enough so that each succesive layer of wire will have tape between the piece of brass and the turns of wire on each side of it. Put another tap on the end of the second 600 turns and wind on another 600, not forgeting to shellac each layer of the coil and to put the piece of cloth between the layers the same as you did at first.

Solder a tap at the end of each 600 layers until you

come to the fourth tap. You should now have 4 taps all in a row and in order that you may make no mistake you can now put a label on each tap and on the inner end of the wire that you passed through the hole in the spool head. Mark the inner end 400, the first tap 300, the second tap 200, the third tap 100, and the fourth tap 0. Now wind on 50 turns and solder on a tap marking it 5, another 50 turns and mark tap 10, and so on marking the tap at the end of each 50 turns 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85 90, 95 and 100. The taps from 0 to 100 should be placed in such a position that they will occupy another line a little separated from the line occupied by the first 4 taps. Finally wind a layer of tape over the outer layer of wire to keep everything in place. You will now find that if you have wound tightly and the pieces of cloth used between the layers have been no thicker than a thin handkerchief, that your spool will be just about full and it should be let stand for a few day to thoroughly dry in a dry place.

Remove the 2 bolts in leg 4^2 of the core, open the joint and slip the spool in place, close the joints and replace the bolts. You will find some considerable difficulty in putting the joints together and it will help you wonderfully to cut a number of pieces of thin iron or tin about 1 1/2 inches square and bend them to the shape shown in Fig. 4. Place one of these over each long section of the ends of the core and then you will have but little difficulty in putting the joints together and you can remove the pieces of tin with a pair of pliers after the joints are well entered into place.

We should have told you that in drilling the hole in the spool head for the inner end of the wire it should be drilled over the center of one of the sides of the square hole as if it is drilled over one of the corners of the square hole, it will come dangerously near to the iron core when the spool is put in place. Then another thing that you must be ecareful about is to so place the spool on the core that this same inside end of the wire will be as far away from the core as possible.

Your transformer is now complete and you can either mount it on a board or in a box and solder rubber covered No. 16 wires to the different taps and lead them to properly numbered binding posts either on the outside of the box or on the base board.

If your circuit is 52 volts or thereabouts you can now connect the circuit to numbers 0 and 55 or to any other two numbers that have 55 turn between them, or even 50 turns will not be too few. If your cicuit is 104 volts or thereabouts you should connect to numbers 100 or 10 or any other two numbers that have 100 or 110 turns between them.

After the transformer has been duly connected as above to either a switch or key socket you can turn on the current and if you have been careful with your work only a very small amount of current will flow through the coil and if you have a 5 ampere fuse in circuit it will not blow. If, however, you have failed to properly insulate the pieces of brass or copper from the adjacent turns of wire with carefully placed tape, or if you have been careless with your work in one of many other ways, you will perhaps have a short circuit and even a 25-ampere fuse will be instantly blown and you will have to unwind your coil and find the trouble.

Assuming that everything is all right you can connect a wire to number 0 and another to number 5, this will give you 5 volts for your work, 0 and 10 will give you 10 volts, 0 and 15, 15 volts, and so on until you get to 0 and 100 which will give you 100 volts. To go above this remove the one wire from 0 to 0100. This will mean that you must add 100 to the number to which the other wire is connected so that if it is at 15 you will have 115 volts and if it is at 95 you will have 195 volts. To go above 200 you must remove the one wire from 0100 to 200 and this will mean that if the other wire is at 35 you will have 235 volts. To go above 300 remove wire from 200 to 300 and to go above 400 remove it from 300 to 400 which will give you up to the limit of the transformer at about 500 volts.

You must be very careful not to allow bare wires to touch and thus short circuit a portion of the transformer and either overheat it and perhaps burn it out or blow the fuse. Then again don't forget that a voltage above 200 is dangerous and sometimes fatal so you must use the utmost care in handling your transformer and it is wise either to keep one hand behind your back or else use good rubber gloves.

One of the purposes that this transformer is very convenient for is to heat the wire used in the building of induction coils. When the sections of your coil are all stacked up and the connections made, whether the wire has been wound in wax or not, you should pass a current through the wire sufficient to warm it and thus drive out all moisture, and if the coils have been wound in wax this treatment will soften the wax and allow the sections to settle down upon each other and after cooling it will be found that the whole is one solid mass. Be sure, however, that you do not overheat for you must remember that the heat inside of the coil is much more than that which you feel on the outside and it is easy to char the insulation and thus ruin the coil. The way to do is to try a small voltage for a few moments and then gradually increase until you get enough voltage to drive sufficient current through to warm the coil. It may happen in very large coils that 500 volts will not be enough and in such a case warm up half of the coil at a time.

While this transformer is designed for a frequency of 60 cycles it will work equally well on a higher frequency.—"The American Inventor."

Approximately 30 per cent. of the cost of producing iron ore in the Lake Superior region constitutes mining supplies.

DECORATIVE ENAMELLING.

II. Two Brooches in Cloisonne Enamel.

Both the jewellery worker and the silversmith find the use of enamel of great value in forming a suitable decoration for their work, and in this article are given two designs of easy construction, useful to enamellers for this purpose.

The design illustrated in Figs, 1 and 2 is a suggestion for a plain leaf arrangement springing from the outside border of the panel. The colors to be used will, of course, depend on the individual taste of the worker, but it would be as well to make the leaves a shade of green, and contrast them with a groundwork, say, of brown or purple-brown, or even another shade of green. Suitable combinations of greens and other colors may easily be seen by studying the foliage in the garden, and choosing some colors that harmonise in their natural forms. In this way it is possible to get some beautiful combinations of colors, which are much better than any haphazard selection from the stock of enamel in hand. As explained in the previous article, the word cloisonne is given to that form of enamelling where cloisons, or thin strips of wire, are soldered on to a base to make a cell which contains enamel. To fully illustrate this, the side view of Fig.

FIG. 1.

FIG. 2.

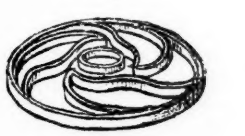


FIG. 3.

2 shows the cloisons fixed in their positions, and the section is taken through the diameter of the panel; in Fig. 3 is given a sketch showing the panel, with cloisons soldered down, quite ready for the reception of the enamel. In case the worker may think this design too dificult for a commencement, another is given in Fig. 4 and this is composed of a round panel, with a rim and containing four circles, each made of a strip of metal and soldered up and then soldered to the base.

To make a commencement with the work, we will take the design for Fig. 1, and fixing on a size, say, of 1 1/4 diameter of panel, as shown, we must take a piece of copper, or silver, about 22 S. W. G. and cut it to the shape. It must be domed to the shape shown in Fig. 2 and then placed in the hydrochloric acid pickling solution to be thoroughly cleansed, and next it should be planished on a stake and again pickled. The next step is to prepare the strips for the cloisons. The silver may be bought in lengths, ready rolled to a ribbon and of a suitable size, but the strips may be made by either cutting them carefully from a thin sheet of silver or hammering out a length of wire on a flat stake. With care the latter method is as good as any, although the metal rolls would ensure perfect evenness. Having provided sufficient, make an outside rim and solder it together, by tying a length of binding wire around it, touching the joint with borax and then placing a snippet of solder on and holding in the spirit flame. Next clean the rim in a sulphuric pickle and solder on to the base.

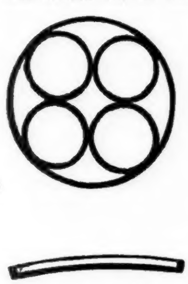


FIG. 4 & 5.

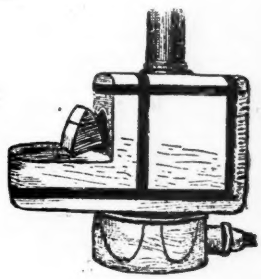


FIG. 6.

The worker may have found some considerable difficulty in keeping the small bits of solder in place during the bubbling up of the borax on first heating, and it will be found very helpful if some borax is thoroughly fused and then ground down to a powder in petroleum. The borax solution thus obtained may be kept in a wide neck glass stoppered bottle and taken out with a dipper made from a bit of copper wire, melted at the end and flattened out as a kind of spoon. The borax may now be placed where required and will not bubble up at all and the petroleum will not affect the solder in the slightest degree.

We will now bend one of the leaf shapes, see that the ends fit neatly against the inner edge of the rim, and the lower edge flat on the base, and then cover the lower edge with borax and place in position, put a few small bits of solder in position and flush them, pressing down the cloison to ensure it being flat. It is not necessary to solder them completely to the base, just sufficient to keep them in position, for a good many workers do not solder their cloisons at all, but this is not a satisfactory method for the beginner, because of the risk of the cloisons moving while the enamel is being fused. When the three leaves and the center ring have been soldered down, we must prepare a bed for it, for, being domed, the work will twist under the great heat required unless supported. The

best support to use is a mixture of plaster of Paris and pipeclay, mixed together to a paste with a little water. This paste is moulded to the shape of the underneath of the pearl and is placed on a small bit of iron, pierced with a few holes, also covered with the paste, to prevent any oxidation of the iron. The iron is to form a cradle to hold the article whilst in the furnace and may be domed to fit underneath the panel if desired.

The work should now be thoroughly well boiled in a sulphuric acid solution and any projections of solder along the edges of the cloisons or on the base must be scraped off. Before the spaces are filled with enamel, the back of the panel must be painted with enamel, Any suitable colour may be used and should be mixed with a little gum tragacanth. The gum is necessary to make the enamel adhere, or else being underneath, would fall off while being fired. The enamel for the front should now be placed in, and the best method of doing it is to use a perfectly clean penknife and pick some up and press into place, taking care that the colors do not get mixed up. Next the surplus water must be taken up with blotting paper, using

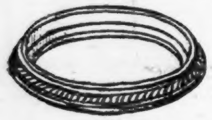


FIG. 7.

FIG. 8.

the very best quality. Clean linen, or cambric rag may be used, but the greatest care must be taken to prevent fluff from getting on the enamel. The enamel should now be dried on top of the furnace and then is ready for firing. We now come to one of the difficulties of enamelling, for a question of expense comes to the front.. The only method of doing the best work is to use a muffle furnace (Fig. 6), a small one with gas burner costing about $10. The time necessary for successful fusing if the enamel depends on the kind used, and if a thoroughly permanent effect is required, then the hardest enamels should be used on a small piece of work, about 1 1/2 minutes in a well-heated muffle furnace will generally be sufficient.

If, after the firing, it is found that the enamel has not filled up the spaces completely, the plate should be placed in a sulphuric acid pickle and any uneven parts rubbed down with a corundum file, and then the bare spots covered with enamel and refired, but it is advisable to anneal the plate before the second coat of enamel is applied. It is quite possible to place a different transparent enamel on another; for instance, a yellow on a deep blue, giving a shade of green, and if the plate is frequently annealed, it is surprising what may be done with it. The amateur may desire a quicker and cheaper method of enamelling, and if the work is small, say about 3/4 in. to 1 in., it may be treated in a spirit flame. The enamel should rest on a thin plate of iron, perforated with small holes and the underneath of the enamel place resting on a bed of clay and supported on an iron wire frame. A very suitable flame to use is that obtained from the lamp usually supplied to boil kettles.

Another way of firing small pieces of enamel is to get a crucible, place it on a firebrick on its side, place the enamel inside, properly supported, cover up the end of crucible and then build up a few pieces of firebrick around it to retain the heat. The heat should be directed on to the crucible with a large blowpipe, such as those used for brazing, and it is quite possible to do good work in this way. When the enamel is successfully fired, polish up the surface with putty powder, first filing down the projections, if any and then the work is ready to mount in a suitable frame.

A sketch is given in Fig. 7 of a very suitable form of mount for an enamel brooch. It is a thin band of silver about the same width as the outside thickness of the enamel, and of the same diameter, so that it is just the right size for the enamel to fit in. Next solder underneath a flat ring of silver, which should project inside and outside the band, sufficient inside to support the enamel and outside to hold a ring of twisted wire. Underneath this flat ring are soldered on the pin and catch, as will be seen in Fig. 8. Boil out the work, polish up with pumice and then with rouge and place in the panel, burnishing over the top to hold the enamel in place.

ALUMINUM CASTINGS.

Aluminum castings can e made in any ordinary foundry fitted for making brass castings, says the "American achinist." A graphite crucible should be used, and the metal is melted preferably over a coke fire. If this is not convenient, a fire of charcoal, oil or gas can be used, and they are desirable in about the order named. The great object is to use a fuel which is free from nitrogen and phosphorus. It is not advisable to use either hard or soft coal, because these fuels produce more or less of the above gases, which to a certain extent will be absorbed by the metal and occasion blow holes.

If it is desired to obtain an aluminum casting with a fine surface, the best results can be secured by first facing the mold with a fine sand, which has been thoroughly dried. Then, after the mold has been faced with the sand, it should be baked with the smoke of a gasoline torch. If these precautions are followed, the ordinary brass founder will have no difficulty in making successful aluminum castings.

Alloys of bismuth have been employed for fusible plugs for steam boilers and in fire extinguishing apparatus; but lately it has been found that these plugs alter peculiarly when exposed to heat for any length of time, and often will not melt at the proper temperature.

THE STORAGE BATTERY.

H. L. STRONG.

The history of the storage battery is older than that of the modern steam turbine, and its application is broader; but in either case there seems to be little reliable data or information obtainable which will throw much light on their economic operation or reliability. The reasons for this seem to be that they are comparatively new and the manufacturers are "saying little and sawing wood," hoping, in time, to improve and perfect their product to the end that they may be more efficient, longer lived and better fulfill the requirements and expectations of those who may invest their money in such apparatus. In many instances, both in large and small installation , storage batteries are proving very satisfactory in operation, and are good investments. One company, at least, in the United States is installing them in many large plants and taking their pay on a profit-sharing plan.

This seems to prove that, where conditions are favorable, a battery will reduce operating expenses. There are other cases where a battery is a great convenience, or where desirable results can be obtained with it which are difficult or impracticable without it. Most of the failures and consequent disappointments in battery installations are due to lack of knowledge of their limitations and requqirements. By this I mean that batteries are sometimes installed and operated under adverse conditions, and then storage batteries in general are condemned as being expensive, troublesome and unreliable. The conditions and requirements are so varied that it is not practicable to attempt to cover the ground thoroughly, especially in a short article, but a few lines in this connection may not be amiss.

As a few of the puropese for which storage batteries are used may be mentioned: Telephones, wireless telegraph installations, experimental work, driving automobiles and electric launches, firing submarine mines, lighting cars, yachts and other small vessels, lighting private residences, etc. The principal purpose for which they are used in electric light and power plants, and that for which they are best adapted in this line of work, is for helping the generators on peak loads and acting as a reserve for emergencies. In direct current systems, where the load is continually fluctuating, as in railway work, storage batteries give good results, for they are not only availible for peak load periods and emergencies, but also keep the voltage steadier and the load on the generators more uniform. When used in this way they are connected to the line in parallel with the generators, usually at some distance from the generating station, and are said to "float on the line." When the line voltage is normal the battery is idle, but should the line voltage drop a little the battery will feed into the line. If the voltage rises above normal, current will flow to the battery and charge it. A booster is used to run the voltage up high enough to give the battery a full charge once per week and a normal charge oftener if necessary.

One of the arguments in favor of storage batteries in electric plants is that by their use less generating capacity is required in providing for peak load periods, and, therefore, it is possible to operate the plant with more uniform loads and consequently with better efficiency. Just how this pans out in practice is not easy to determine, and I have never seen any data or figures in this connection. Under laboratory conditions, the efficiency of a storage battery is said to be not over 85 per cent., and from my own observation and what I have been told by those who should know, the efficiency under working conditions probably averages about 75 per cent. However, there are practically no stand-by losses, and a battery is ready to take a load instantly. It is also capable of taking heavy overloads of short duration, although heavy discharges of any considerable duration are neither economical nor desirable. A further advantage is the slight voltage variation on variable loads as compared with a generator operating unaided under similar conditions. It is a mistake, except in special cases, to install a battery with the idea of letting it carry heavy loads, especially of long duration. When fully charge a battery will supply its normal rated capacity for about eight hours, but a battery that is worked to the extent of a normal charge and discharge every twenty-four hours will only have a life, at best, of from three to four years. This statement is based on recent information and the most reliable that I have been able to obtain. With proper care and an average daily discharge of 40 to 50 per cent., a good battery will probably last about eight years.

It has been estimated that on an allowance of 10 per cent. per annum for depreciation and repairs, a good battery will last indefinitely. This estimate may strike an average, but I am inclined to think that it is none too liberal. It all depends on how hard the battery is worked and how well it is cared for. Ordinarily a battery requires no more care than a generator, and may safely be left alone for hours, or, in many places, for days at a time. Most of us know how electric elevators or even motors for other purposes will play the mischief with the lights in a place where both are operated from a small generating plant. A storage battery, properly installed, in such a place will greatly improve the lighting service and cause the generating

machinery to operate much more smoothly. As to whether a battery will prove a money-saving investment in such a place is another question. However, the improvement in the service, and the greater security against total interruption of the service may be worth some extra expense.

In hotels and many other places there are periods during which but little current is used, and if a battery is installed the generating machinery need not be run for the light loads. If in addition to this, it is also practicable to reduce the labor expenses, there is little doubt but what a battery will give a good account of itself. As an example of this we have the following instance which is from actual practice:: A small electric plant is operated where there is a demand for current twenty-four hours per day, although the maximum load period is between sunset and 11 P. M. After 11 P. M. the load does not exceed 75 amperes, at 115 volts, and after 8 A. M. very little current is used, even during the short days. There are but two ways to handle this proposition. One is to run a generator continuously, and the other is to install a storage battery, and let one crew operate the plant by running the generators during the heavy load period and putting the light load onto the battery. In this particular case a $5,000 battery installation will save money in competition with any practicable scheme of operating a generator alone, because no attendant is required at the plant when the battery is discharging. If it was necessary to have some one at the plant all the time there would not be much to say in favor of the battery, although I believe it would be advisable to install a small battery to supply what little current is used during the daytime.

For private residence lighting, the storage battery is being extensively and satisfactorily employed. Some form of internal combustion motor is generally used to drive the generator for charging the battery. Some people even install a battery in their residence to guard against being left in the dark by failure or interruption of the commercial supply of current. The battery is kept charged and is provided with an automatic switch, which will instantly throw the lights on to the battery, should the commercial supply be interrupted. The action of the switch is reversed when the commercial supply is restored. This is getting it down finer than most people consider necessary or are willing to pay for, but a battery in such service should last indefinitely, with but little expense and care.—"The National Engineer."

A British naturalist recently recovered two live toads which had been buried in solid rock for unknown periods. One of the toads had been dug out of clay six feet below the surface, and the other was found embedded in a quarry. The only infirmity noticed that both had their mouths tightly closed; otherwise they were active.

STANDARDIZING BARONETERS.

We are indebted to Mr. Max Kuner, nautical optician, 94 Columbia street, Colman building, Seattle, for the following interesting description of the standardizing of the Aneroid barometer as daily practised by him:

"The apparatus used by us consists of two mercurial column barometers, and an air pump with mercury column attached. The two mercury barometers were first standardized in this manner:—They were carefully corrected for capillary attraction by moving the scale to the proper point. Then as a constant error there was an error for height above sea level to be subtracted. An error for local gravity to be added. These are constant error. There remains the temperature error; this is a variable one. (All barometers in the U. S. are reduced, for purposes of comparison, to 32 degrees Fahrenheit, sea level, local gravity, as at Washington, D. C.). Our two barometers are compared each day at 5 p. m., and after subtracting the algebraic sum of the errors are compared with the Weather Bureau reading, thus preventing all chance of error. (We have never got a variation, both barometers reading alike in every case).

"The method of testing is as follows: the correct height of the mercury column is read off both barometers, and the correction for temperature subtracted. If the aneroid is compensated it corrects for temperature and so reads different from our standard. The mercury column on the machine is set to read this height by shifting the scale. The aneroid to be tested is set to the same reading and placed under the bell glass and the air exhausted. Every half-inch the column and the aneroid are compared and the aneroid's error, if any, noted. When the limit of the aneroid's scale is reached the air is allowed to enter slowly and the reading and error noted going up the scale. The aneroid then goes out with our written certificate and its character and faults are known to the user, thus making it a dependable instrument. Without this precaution the aneroid is a mere guessing machine, but when properly corrected is an instrument of the utmost delicacy and accuracy, ranking above the sympiesometer and the mercury column. This is especially true of the modern holosteric compensated aneroid (Holosteric means flat spring, and is used in contradistinction to the older spiral spring aneroid). If there are errors of adjustment, we carefully correct these, in order that navigators may have a dependable instrument. This method of standardizing is identical with that practised in the observatory of the National Physical Laboratory, Kew observatory, England."

In the last 500 years more than $12,000,000,000 worth of gold is estimated to have been dug from the earth. Not much more than one-half of this is definitely known to be in existence in the monetary stocks of the globe.

ENLARGING FOR BEGINNERS.

"ALAR."

Amateurs usually find or imagine enlarging very difficult or costly, and it is for them that I feel inspired to write a few practical hints on the subject from my own experience.

The very words "bromide enlarging" had something mysterious in sound to me, indeed I know nothing about bromide papers yet, but I have spent my spare time for several days experimenting with a home-made enlarging apparatus until I have mastered it for enlarging on rapid developing paper, such as Velox or Yunox.

I did not succeed with papers requiring a longer exposure.

In the first place, I wanted to take pictures somewhat larger than 4x5, so purchased a long focus camera taking a 5x7 plate. If I had it to do over again, I would be satisfied with a 4x5 camera with long bellows, as it would be far more convenient for ordinary work, less bungling to carry or handle, and if I wished a larger picture, all I need is to have an apparatus ready to enlarge it at home. The results would be far cheaper than the results from 5x7 plates, etc., and, rightly done, as good.

Of course one should first master ordinary printing with developing paper.

For my enlarging apparatus I found a light packing box somewhat over 3 feet long. The length needed would depend on the sized picture one might wish and the focus of the lens. My box was about 13 in. wide by 10 in. deep, my lens of 8 1/4 in. focus; so I could make a picture 10x12 in., about as large as I cared to attempt without spending too much for trays, etc., and I doubted my ability to handle larger prints. With a lens of the same focus, if one wanted larger pictures, a large and longer box would be needed.

I removed the reversible-back from my camera, and made a holder to fit the back with pasteboard and glue, to hold a 4x5 plate. Other holders could be made for any sized plate. One would require very stiff pasteboard, I used the backing on kokoid plates, which I happened to have.

Having made the holder and put a negative in position bottom up, in the back of the camera, I placed the camera box with the back against a square hole, which I had cut in one end of the box. The hole should be nearly as large as the back of the camera, and just where the back comes against it. With some little cleats on the bottom of the box, I fastened the camera firmly in place, then raised a north window, put that end of the box under it and darkened the rest of the window and other windows in the room with curtains; so that the room was not light enough to fog developing papers while handling and developing, as I wished to do all the work as handily as possible.

Having placed a sheet of white card —10x12 in.— in the room end of the box I opened the camera shutter and drew out the bellows until I could see a fairly clear copy of the negative enlarged on the pasteboard slide. Now came the difficult part, possibly the fault of my eyes, but I found I could not focus it properly by sight. When thought Iit was perfectly focused, a print would show haze. By experimenting I found that the picture seemed focused to me anywhere within a two-inch draw of the bellows, but the print knew the difference.

I think I would have given up in despair if one of my first efforts at printing had not chanced to turn out sharp.

I had arranged the room-end of my box, so that the sheet of white cardboard—a very stiff, straight one, by the way—could slip between cleats on the sides of the box, and so be placed either nearer or farther from the lens, so that I could vary the size of the enlargement. The sheet of developing-paper was to be pinned to this cardboard slide. The slides between cleats were numbered according to the number of inches from the camera front-board; for instance, with my camera, 22, 23, 24, 25 and 26. Placing the slide at 23, I focused it by my eye, measured the exact distance from pasteboard slide to lens-board, placed a small piece of developing paper across some sharply defined part of the picture and exposed the right time, which must first be found for the negative one is working with. My negatives required from 1 to 8 minutes with the papers mentioned. If, upon developing the piece, I found the result hazy, with the lens-board 20 inches from paper, I drew out the bellows a quarter-inch more and tried again and yet again till I got the exact focus, then wrote the number of inches extension for that slide down in my notebook for future reference, and tried another, till I had them all properly focused, and could enlarge a 4x5 plate to any size from a 4 1/2 x 5 3/4 up to 10x12, or thereabouts. As long as I use this box, the focusing need never bother me again.

I had some smooth pieces of board to place across the top of the box while exposing, so that noextraneous light would fog the paper The window-end of box should be securely darkened so that no light will reach the paper from that direction except through the lens. A piece of dark cloth tucked in around the camera is sufficient. If there is shrubbery near the window, it is better to tilt the box so the clear light from the sky can shine through the negative.

When not in use, my box is stood on end in some out of-the-way corner.

Possibly some beginners may not at once see the good to be gained by all this bother. However, they would see if they had uselessly carried a 5x7 or larger camera, for very long; but there are other advantages besides getting a larger picture with less expense and trouble. Sometimes part of the negative is spoiled or uninteresting, but one little part would make a picture if large enough. Get out your enlarging outfit, focus that part to the size wanted—a 4x5, if desired—and you have a picture you wanted, without taking another plate. Get a sharp negative and enlarge what you want to a 4x5 size and print it. The various surfaces of developing paper should give what is wanted, even for newspaper work.—Western Camera Notes.

CONSTRUCTION AND MANAGEMENT OF GASOLINE ENGINES.

CARL H. CLARK.

X. Reversing Gears.

The gasoline engine, unlike the steam engine, has no ready means of reversing. Although most two cycle and some four cycle engines will run in either direction, the means of accomplishing it are cumbersome and not always certain. Some few engines have permanent reversing gears which work fairly well, but the majority of engines must practically be stopped and started in the opposite direction. It is possible to reverse a two cycle engine by a proper manipulation of the timing of the spark, as will be explained under the handling of engines; it is, however, not to be relied upon. This fact and the fact that most four cycle engines run in one direction only, necessitates the adoption of some form of outside reversing device. Engines of small power fitted in light boats can be run without any reversing device, but engines of over four or five horsepower should always be so fitted.

The simplest form of reversing device is the reversing propeller, which is fitted with a device for twisting the blades, to the reverse angle, causing the propeller to act in the opposite direction with the shaft always turning one way. Fig. 68 shows a sketch of a two blade reversing propeller. The shaft is made hollow, with the rod R moving longitudinally inside of it. This rod is round inside of the shaft and square in the propeller hub. On one side of the square end of the rod is the groove a running diagonally across it. The

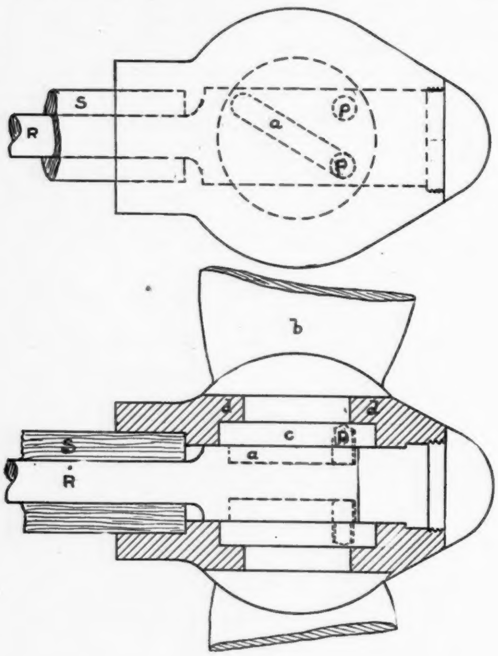


FIG. 68

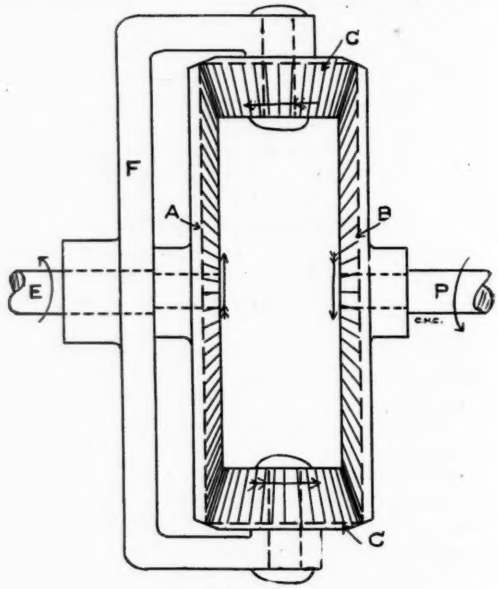


FIG. 69

blade b, is provided with the collar c, which fits under the projections d of the hub, holding the blade in place, while allowing it to turn. The face of the collar C bears snugly against the flat of the rod R. On the under face of the collar c is a pin P which projects down and fits into the slot a. It will thus be seen that if the rod R is moved along the shaft the pin P will slide in the slot A and thus turn the blade of the propeller. When the rod is in its extreme right hand position, the pin P will have moved to p, having swung across the center line into the opposite position and causing the blade to take an angle opposite to its former one and

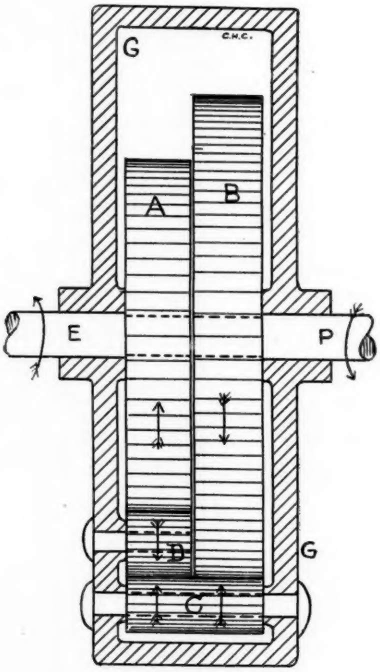


FIG. 70

to exert its force in the opposite direction. At some point about midway between tnese two, the blades will be practically at right angles to the shaft, and will turn without exerting any force. By turning the blades slightly either way a slight force will be exerted. Thus all speeds may be obtained, from full speed either way down to nothing. This allows the boat to be easily handled and even stopped entirely, without touching the engine.

The other blade is on the opposite side of the hub, and is operated by a pin in a slot on the opposite side of the flat end of the rod R and both blades turn together. The driving shaft S is hollow for the rod R and on its inboard end has an attachment to allow the rod R to be moved back and forth.

This form of propeller is a cheap and fairly satisfactory way of controlling the speed. If properly constructed it is nearly as strong as a solid wheel; the majority of reversible wheels on the market today are, however, poorly disigned and of flimsey construction and care must be taken in the selection of such a wheel. It should also be stated that the shape of the blade can be correct for one position only, and for all others it is more or less unsuited. For this reason, unless the correct position happens to be hit upon for the full speed, a certain loss of power is apt to follow. A reversible blade propeller is thus very likely to waste more power, and give less speed than a solid propeller.

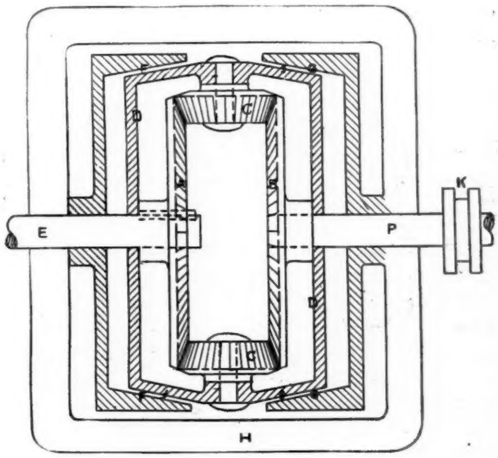


FIG. 71.

For engines of over six horse power a reversing device of the geared type must be used. These may for the present purpose be divided into two types, those using bevel gears and those using spun gears. Fig. 69 shows a diagram of the former type. The engine shaft E carries the large bevel gear A and the propeller shaft P carris a similar gear. The frame F encircles the shaft E and has bearing carrying the bevel pinnons C which mesh with the gears A and B. The frame F has two locking devices, one of which locks it to the shaft E and causes it to revolve with it. The other device locks it to the engine frame, holding it stationary and allowing the shaft E to revolve independently.

Suppose now that F is locked to the shaft E and turns with it, the gears C and A are thus locked together, and in consequence the entire gear revolves together and the shafts E and P turn in the same direction. This is the forward speed. If, now, the frame F is unlocked from the shaft E and locked to the engine bed so that it cannot turn, the gears C. C. will be brought into action. If the shaft E continues to revolve as shown by the arrow, th gears A-C-B will turn in the direction of the arrows and the shaft P will turn, as

shown by its arrow, in the opposite direction to E. This is the reverse motion.

Suppose now that the frame F is left free, the shaft E may turn and the gears C will simply roll around on B without turning it, and the shaft P will remain stationary. This allows the boat to be stopped without stopping the engine and also permits the starting of the engine without the labor of turning the entire shafting and propeller.

Fig. 70 shows a diagram of the spur gear type of reversing gear. The engine shaft E carries the gear A while the propeller shaft P carries the gear B. These are enclosed in a case G. A bearing on the side of case G carries the pinion D which is in mesh with gear A. The pinion C also carried by a bearing in case G meshes with pinion D and also with gear B. There is thus formed a complete connection between gears A and B. As before, the case G is arranged to be either connected to revolve with shaft A or to remain stationary. Suppose now that case G is locked to the engine shaft A. This locks the gears inside of the case and drives A and B together thus driving the propeller shaft in the same direction as the engine shaft. Suppose now that the case G is released from the shaft E and prevented from turning by locking to the engine frame. The gear A causes the pinions D and C to revolve, thus revolving the gear B and shaft P, but in the opposite direction to that of shaft E. If the case G is left free, while the shaft E is turned it will simply revolve idly without moving the gear B thus allowing the engine to run idly as before.

It should be noted that the gear described in Fig. 69 reverses the propeller shaft at the same speed as the engine shaft while in that of Fig. 70 the reverse motion is slower than the forward motion in the proportion of the diameters of the gears A and B. The radius of A is reduced by the diameter of the idle gear D which gear is necessary to produce the reverse motion. This difference in speed is of little account, as a reverse at full speed is seldom necessary.

Fig. 71 represents the application of the bevel gear reverse. The bevel gears are contained in a sort of cast iron case or drum D which has bearings for the gears C-C. The outside of the drum D has the two conical friction surfaces f and g. The two pieces F and G have corresponding conical surfaces fitting f and g. The piece F is fastened to and revolves with, the shaft E while G is stationary and fastened to the base H. The gear A is not rigid on the shaft E but is fitted over a spline or key, which allows the gear to move along the shaft and still be driven. The drum D is a running fit on the shafts E and P allowing them to turn easily. A fork fitting into the grooved collar K, allows the shaft P and the drum D to be moved slightly. Suppose it to be moved to the left, bringing the conical friction surfaces F and f into contact. This locks the drum D to the shaft E thus locking the gears inside and driving the shaft P direct. When in the position shown the drum D is free to revolve either

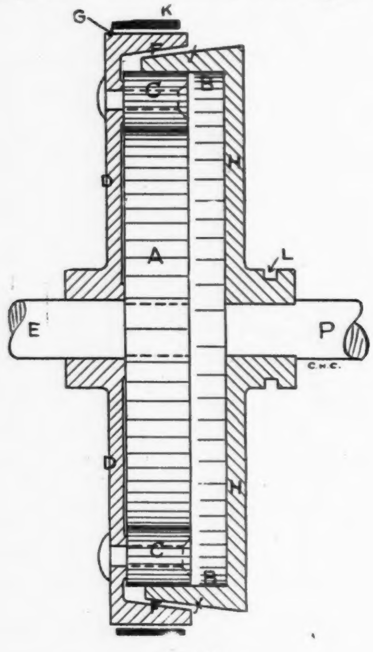


FIG. 72.

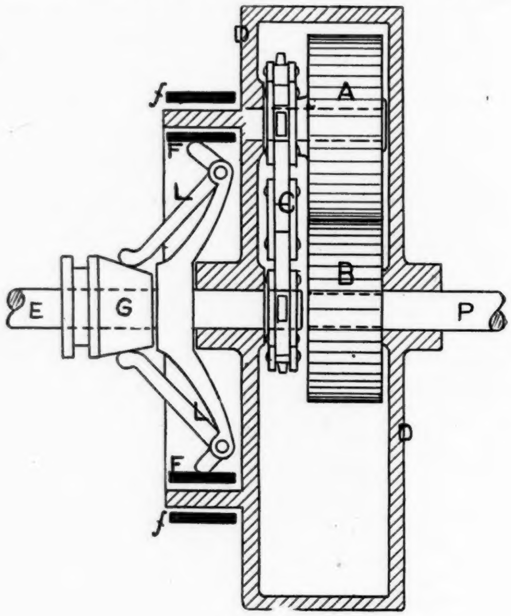


FIG. 73.

way, and whatever may be the motion of the engine shaft, no motion of shaft P will result, as the gears C.C. will simply roll around on gear B without causing any motion. Suppose again, that the shaft P and drum are moved to the right bringing the friction surfaces G and g into contact. Since G is stationary the drum will become stationary and the gears will come into play, producing the reverse motion as before described. The slight fore and aft motion is allowed by the leather in gear A without drawing the gears out of mesh.

Fig. 72 shows a spur gear reversing clutch similar to that of Fig. 70 but using an internal gear. E is the engine shaft carrying the spur gear A. A shallow case D, which is loose on the shaft E, carries the pinions C. C. Two pinions are provided to distribute the wear. This case D is provided with the conical friction suriace F on the inside of its rim, and the parallel friction surface G on the outside of the rim. The propeller shaft P also carries a shallow drum H, having on the outside of its rim a conical friction surface fitting into that on D and on the inside an annular gear B which meshes with the pinion C. A fork fitting into the grooved collar L allows the shaft and drum H to be moved fore and aft. A friction band K on the outside of drum D is tightened by a wedge and holds the drum stationary when desired. Suppose the shaft P and drum H to be moved to the left; this will bring the friction surfaces F and f into contact, locking the gears, and driving everything together in the same direction. As shown in the sketch the drum D is entirely free and the shaft E may turn without turning the engine shaft. If, however, the friction band K is tightened the drum D will remain stationary, the gears will come into action and the shaft P will reverse.

In another form of gear, the engine shaft carries a sprocket and chain C, the drum D carries a bearing for the gear A to which is fastened the other sprocket of the chain C. The propeller shaft carries spur gear B similar to A. At F is a friction surface for connecting with the shaft when the tapered collar G is moved to the right the levers L are pressed out and the friction band F is expanded, driving the whole with the shaft. As shown the gear is in the free position. The friction f is tightened by a wedge. When this done, the drum D remains stationary. and the drive is through the chain and gears producing a reverse motion of shaft P.

The prime requisites of any reverse gear are that the gears should be in mesh at all times to avoid stripping, they should also run in oil, to reduce wear. It must be so arranged that the two frictions cannot be put in action together which would damage the gear. The gears should be in action only in reverse motion.

All reversing gears will be found to embody one or more of these principles and with this explanation no difficulty should be found in understanding the action of any type of reversing gear.

LONG DISTANCE TELEPHONING.

The use of the copper wire for the telephonic service was the beginning of its great extension. The New York Tribune says that the first copper telephone wire was about the size of tthe iron telegraph wire it replaced. With improved "long distance" instruments, such as are now in general use for all kinds of service, conversations can be conducted over wire of this size for about 350 miles with what the engineers call "standard transmission." By increasing the size of the copper strands on their long-distance lines they have more than doubled the early limits of successful transmission. The problem before the engineers has been to find a way to prevent the telephone current from "decaying" during the ourney of a message over the lines. That is, the engineers have sought means to counteract the inevitable loss of efficiency in the current and to keep it as near as possible at its original strength. Two methods of doing this have been tried. Separately they have worked out well; but as yet they have not been applied commercially to the same line. The two devices that promise so much for the extension of the range of londistance talking are the loading coil and the repeater. Though the ends they accomplish are, to a certain extent, the same, the principles on which they work are entirely different. When the electrical current from the transmitter of one telephone starts out on its journey to the receiver of another telephone a thousand miles away, say, it loses strength fast, sinking away by degrees until finally it becomes too weak to reproduce vibrations distinctly. The loading coil, which was invented by Professor Michael I. Pupin of Columbia University, acts as a sort of stimulant. It consists of an iron core upon which is windng upon winding of fine wire through which the talking current is passed in such a way that it is strengthened against the decaying processes and maintained at a level high enough to give satisfactory transmission. These coils are attached to a line two, four or maybe eight miles apart, and their use approximately doubles the range of the telephone. The repeater, which is a later invention, operates differently. As its name signifies, it actually repeats the message, which, coming through a receiver reproduces itself automatically on a transmitter. This allows of putting new current into he line, just as the original current is introduced at tthe transmitter of the subscriber's telephone. The result is practically to start the message all over again with a fresh lease of life, though naturally the force that carries it cannot be made quite as good as new. A repeater in the middle of a long-distance circuit extends the range of talking about fifty per cent.

Pennsylvania alone produced last year nearly three-quarters of a million tons pig iron more than the whole of Great Britain.

AMATEUR WORK.

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MARCH, 1907.

HANDY HINTS PRIZE OFFER

Our recent prize offer for articles from readers produced a large number of contributions, but the limited number of prizes prevented all but a few from being accepted. Another prize offer is therefore announced, and this will be a regular standing monthly competition. It is especially designed to secure descriptions of tools and processes used in making machines and instruments, or in doing some special piece of work, likely to interest our readers. The amateur mechanic generally has but a limited tool equipment, and has many times to adapt or design a tool or instrument for the work in hand. Information along these lines is of the greatest practical value to other workers similarly situated, and to obtain it we offer a prize of $5.00 for the best, a prize of $3.00 for the second best article, and $2.00 each for every other accepted article received each month.

These competitions close at the end of the last office day of each month; any article received will enter the competition of the month during which it is received. All articles for these competitions should be labeled "Handy Hints Prize Offer." If not so labeled, they will be considered as being submitted at regular space rates. Drawings should be made in India ink on smooth white paper, and manuscript should have liberal margins and not be too closely written. The prizes will be awarded as nearly as possible upon the following scale of marking:—

Importance or usefulness of the tool or instrument described, 50 per cent.

Literary value of the description, 30 per cent.

Excellence of the drawings, 20 per cent.

It will be noted that half of the value is placed upon the thing described, this being done to secure contributions from those who have information of value, but are not so situated that they can conveniently write the description or make the drawings. This plan furthermore provides that every one who sends an acceptable contribution will receive payment for the same, and the combined efforts of all our readers should be productive of much valuable information.

The third prize in our recent prize offer was awarded to Edmund P. Smith, Niagara Falls, N. Y., and James H. Hunter, Hartford, Conn., the prize being divided between these two. Both contributions appear in this number. Other contributors in this competition will be advised regarding their articles as rapidly as possible.

The article "Attachments for Speed Lathe," by C. Tobyansen, in the February issue of this magazine should have been credited to "Carpentry and Building."

Enormous possibilities for power generation exist in the waste gasses discharged by blast furnaces, coke ovens and other metallurgical furnaces. Much greater progress has been made in utilizing these in Germany than in other countries. It is estimated that the so-called lean gases discharged from the blast furnaces of Germany are capable of developing 1,000,000 h. p. There are now built and under construction in Germany gas engines for this purpose aggregating 400,000 h. p. These are mostly in large units, one firm alone having constructed 140 engines, totaling 120,000 h. p. The utilization of coke oven gases has proceeded more slowly, although the gas discharged from such ovens is of a much higher caloific value than the lean blast furnace gas. The richer the gas enables a greater power to be obtained from an engine of a given size than is possible with the poorer furnace gas, but the lean gas permits a higher degree of compression to be used without danger of premature ignition, this giving the somewhat paradoxical result that the poorer gas enables the higher thermal efficiency to be attained.

The defects noticeable in precious stones are (1) feathers: like rents or fissures in the inside; (2) clouds: gray, brown, or white spots resembling clouds; (3) sands: small bodies like seeds or grains of sand of white, brown, or red color; (4) dust: fine sand disseminated in very fine paticles in a stone.

Lead wool, made in Germany, is used principally for caulking pipes, the joint being filled cold against a backing of hemp or tarred yarn. It is considered a good substitute for melted lead in making joints for hub and spigot cast iron mains. The "blei-wolle" is lead which has been shredded to about the size of heavy thread, collected into bundles of convenient length and of a size in proportion to the joint to be filled, twisted somewhat.

AN OLD ENGLISH BUREAU.

JOHN F. ADAMS.

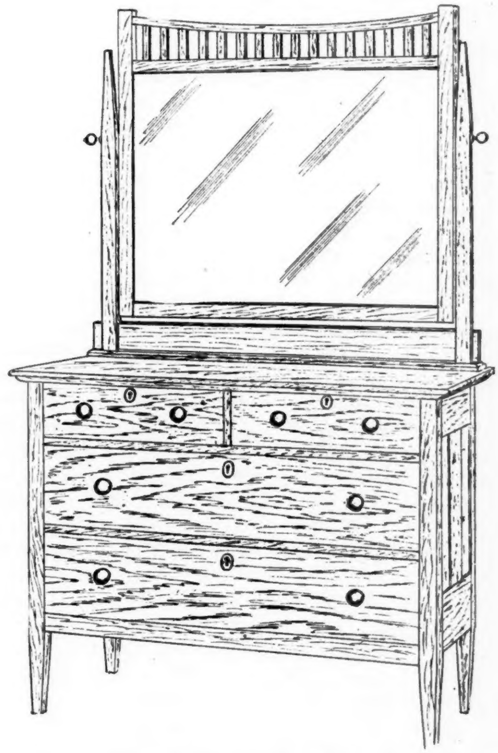
The bureau here described is a companion piece to the bedstead shown in the priveious issue of this magazine. The peculiar feature of the bedstead, the spindles, cannot be embodied in the bureau to the same extent as in the bed, but is included to the extent that is necessary to make it harmonize with the bed. The making of a piece of furniture as difficult as this requires careful work in fitting all joints, and fastening all parts securely together.

The frame and drawers should first be made, the panelled ends being taken up first. The four posts are 2 1/4 x 2 in. and 33 in. long. Beginning 12 1/4 in. from the lower ends, the posts are bevelled off, as shown in the drawing, to 1 1/2 in. square. This dimension depends upon the size and the shape of the castors used, the preferable style having square ferules, to match those used on the bed, so the castors should be purchased before cutting the bevels. The posts are spaced 14 in. apart, making the crosspieces 15 in. long, which allows 1/2 in. at each end for the tenons fitting mortises cut in the center of the posts. The tenons should be 3/8 in. thick. The upper crosspiece is 4 in. wide and the lower on 5 in. wide. They are 15 in. apart, making the center piece between the panels 16 in. long; 1/2 in. on each end is allowed for the tenons. This center piece is 2 1/2 in. wide. The faces of the cross pieces are sunk 1/4 in. inward from the end faces of the posts.

Grooves must be cut in the posts, the grooves being 1/4 in. wide and deep. The panels are 16 in. long, 6 1/8 in. wide and 1/4 in. thick. The ends should be set up between clamps, using care to get the joints well glued, and that the work or glue are not chilled during the work.

The top of the frame is made of two thicknesses of wood, the under one measuring 38 x 17 1/2 in. and 3/4 in. thick. Ordinary stock is quite good enough for this, as it is covered by the second layer, which is 42 x 20 in. and 7/8 in. thick. The second top should be carefully selected to get a good match for the grain, as it will have to be glued up from two or three pieces. A 3/4 in. moulding is run around the edge of the under layer, the corners being mitred. This is not done, however, until after the frame is all assembled. The rear edge of the under top, when put finally in place, should be 1/2 in. from the rear face of the posts, to allow room for the sheathing as will be subsequently mentioned.

The ends are spaced 33 1/2 in. apart. Two pieces 35 1/2 in. long, 2 in. wide and 3/4 in. thick should have tenons cut on the ends, 1 in. long and 3/8 in thick; one pieces being put under the lower drawer and the other between the two back posts, the outer edge of the latter being sunk 1/2 in. inward from the lower ends of tne posts. They are not put in places until the frame is entirely finished and ready to assemble. Two pieces of the same dimensions are put between the drawers, these pieces having the edges at the front and the tenons are only 1 in. wide. The piece between the upper and middle between the middle and lower drawer 7 1/4 in. below the other.



We are now ready to assemble the frame, which we will do as follows:—The pieces between and under the drawers are put in place, first coating tenons and mortises with glue, and also the strip at the lower part of the back. The under top piece is then put on, remembering to leave 1/2 in. at the back for the sheathing, using both glue and screws, and making sure that the spacing is correct and that all angles are square. The pieces between the drawers and at the back should also be pined with 1/8 in dowels. On the inside of the ends are now fastened with screws pieces of 7/8 in. boards 22 in. long and 14 in. wide. As the inner faces

of the pieces should be flush with the inner faces of the posts, it may be necessary to put thin pieces between them and the cross pieces of the ends. The runs for the drawers, 1 x 7/8 in. and about 15 in. long are now fastened with screws to the boards just put in place and the frame is then finished by putting on the backing of 1/2 in. sheathing. The sheathing is fastened with screws to the under top and the piece at the bottom. A division piece between the two upper drawers is made from a piece of board 16 1/2 in. long, 4 1/2 in. wide and 7/8 in. thick. On the front end of this piece glue a piece 7/8 in. square, the grain running vertical, and on the under edge fasten with screws a piece 16 in. long and 3 in. wide to make the runs for the top dawers. This piece is fastened to the under top with screws and glue. In place of gluing on the small piece at the front end of this piece, it can be cut an inch longer and 1/2 in tenons cut on the ends to fit mortises in the top and cross piece between the upper and middle drawers, which would be a preferable way to fit it. The upper top piece is now to be put on by first coating the surfaces of both tops with glue, and then screwing up about a dozen screws, holes for them having previously been bored and countersunk.

The drawers can now be made, and as previous articles have given the construction of drawers, and doubtful points can easily be solved by examining any similar piece of furniture about the house, only dimensions will be given. The upper drawers are 16 5/16 in. wide, 4 1/2 in. deep and 16 1/2 in. long, front to back. The two lower drawers are 33 1/2 in. wide, 7 1/4 in. deep and the same length. The pulls and other trimmings should be those most suitable to the wood and finish adopted by the maker.

The mirror frame can now be taken up and will require three pieces 34 1/2 in. long, two pieces 34 in. long of stock 2 in. wide and 1 1/2 in. thick and about 9 ft. of 3/4 in. square for spindles. The pieces above and below the mirror are 34 in. long, the sides and curved piece are 34 1/2 in. long. The joints at the lower corners are open mortised; those above the mirror and the curved piece are blind mortised; the tenons on the latter being about 1 1/2 in. long. The mirror is 30 x 26 in. and fits in a rabbet cut in the inner back edges of the pieces surrounding it. The curved piece is cut out and the spindles fitted in the same way as described for the bed in the previous issue of this magazine. The edges of the frame around the mirror may be chamfered or not as prefered.

The frame supporting the mirrcr requires two posts 43 in. long, 2 in. wide and 1 1/2 in. thick. The upper 10 in. of these pieces are tapered off to 1 1/4 in. square, and 7 1/2 in. of the lower ends are cut out on the front faces to leave a thickness at the back of 5/8 in. A piece 41 in. long, 2 1/4 in. wide and 7/8 in. thick is beveled on the upper front edge and ends and another piece 36 in. long and 3 in. wide is fitted with tenons on the ends a little over 7/8 in. long which fit mortises cut in the posts located so that the piece just mentioned will lay flat under the ends of the posts where the full thickness begins, and the latter piece with mortised ends come down firmly against it, the two being firmly fastened together with glue and screws. Long screws of good size are also put up through the under piece into the ends of the posts. Pieces 1 in. wide and 3 in. long are also glued to the outside of the posts to represent continuations of the mortised pieces. Reference to the illustation will show what is required.

The mirror frame it attached to the bureau with three screws of good size in each part of the post extending below the top at the back. The mirror pins upon which the mirror frame swings may be purchased of about any hardware dealer, and an inspection will show the proper way to put them on. After the mirror is in place, a layer of thick manilla paper should cover the back before putting on the wood backing, to keep out both dust and moisture which are injurious to mirrors.

PERSPECTIVE VIEWS WITHOUT SKILL.

It sometimes happens that a perspective picture is wanted, either for an assembled view, accompanied by a mechanical drawing of the part, or for other reasons, where a skilled artist is not available (and if he was his time would cost too much to warrant its being used), says George F. Summers in the "American Machinist " It is here a camera comes into play as a drafting tool.

We will suppose, for illustration, that bids for a casting are required, where the patterns are furnished, and it is desired to mail the foundry people blue-prints showing the nature of the work.

A photograph can be taken of the pattern and from a negative a blue-print made, and outlined in pencil emphasizing any points to which especial attention is to be called. The print is then dipped in sodium hydrate, or common lye will do very well, when the blue at once turns into pale yellow, leaving the pencil outline standing out in bold relief, as in the sketch.

It is then a small matter to trace, free hand, the outline on tracing-cloth, making a neat, correct picture of the work at a small cost.

Trial of motor 'buses in Nottingham, England, has shown that for cheapness of operation and maintenance the street car is far superior to the motor 'bus. The cost of rubber tires for the 'bus is 4 cents a mile, as against 2 1/2 cents per car-mile for rail, a difference which amounts to $500 a year for each vehicle. The cost of motive power is also less for the street car and is placed at 24 cents for a ton weight, while the cost for a petroleum motor vehicle is 80 cents.

JIG FOR SHARPENING TOOLS ON AN OIL STONE.

EDMUND S. SMITH.

For the benefit of amateur workers who have found difficulty in keeping a good sharp edge on plane irons, chisels, etc., a device is described below which, if properly made and used, will eliminate the main source of this trouble.

In sharpening a plane iron, for example, on an oil stone the chief difficulty lies in maintaining the tool at a constant angle with the stone on the forward and backward strokes. Any change in this angle of course produces a more or less rounded bevel on the iron as shown in exaggerated form in Fig. 1. When this rounding is at all marked it is next to impossible to secure a sharp working edge. As the degree of rounding of the bevel becomes less, the ease and rapidity with which a fine edge may be obtained materially increases.

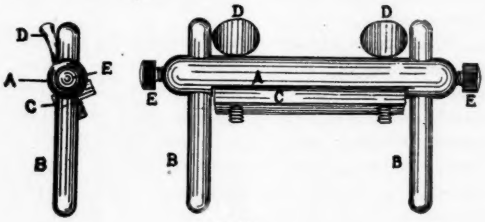


Fig. 2.

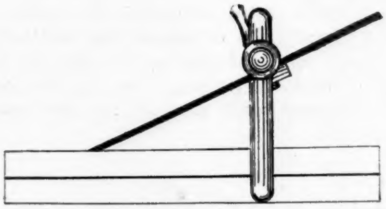


Fig. 3.

Fig. 1.

The desideratum, therefore, is to secure an absolutely flat bevel. To this end the writer devised the holder shown in the drawings, and found that it worked so satisfactorily that it is now offered to any one who may have encountered the difficulty he found in keeping the tool at a constant angle with the oil stone. By its use a tool may not only be ground more perfectly, but even with the extra time required in clamping the tool in the holder an actual saving of time is effected, especially if considerable stock is to be removed as in grinding out nicks, etc.

The device consists of the cylindrical steel bar A, recessed along its central portion to receive the flat piece of steel C, which is clamped to it by the thumb-screws D, D. The rounded rods B, B slide through the bar A near its ends at an angle of about 70 degrees with the flattened portion of the bar. Their position with regard to A is adjustable by means of the knurled screws E, E.

In use, the tool to be ground, a plane iron for example, is clamped between A and C and the legs B, B so adjusted that the iron meets the oil stone at the desired angle, as shown in Fig. 3. For the commoner angles the tool is clamped about four inches from its edge. The legs rest upon the bench (or other plane surface) straddling the stone. The tool and its holder are now moved back and forth over the stone as usual, the resulting bevel being of course perfectly flat.

By adjusting one of the legs so that it is longer than the other edge will be ground at an angle with the side of the tool instead of square with it. This same result is obtained by clamping the tool at any other than a right angle with the bar A. In this way the edge of the tool may be more or less rounded if so desired or it may be ground straight, but at an angle of as much as 45 degrees with the side of the tool. The degree of the bevel is determined by the length of the legs B B extending through A, ad also by the distance the tool is clamped from its edge in the holder. When the bevel is ground the tool and holder are turned over and the flat side of the tool rubbed on the stone to remove the burr, the holder in no way intrfering with its movment.

The most convenient oil stone to use is the so-called "combination stone" made of carborundum or other abrasive, consisting of a coarse and a fine stone cemented face to face. The coarse side is used on very dull tools where considerable stock has to be removed. When this is accomplished the stone is simply turned over and the fine side will soon put a keen edge on the tool.

The size of the holder depends partially upon the kind of tool to be used in it, but the dimensions of the parts given below will be found convenient for a holder to include chisels and plane irons up to 2 1/2 in. wide.

Bar A, 5 1/2 in. long, 3/4 in. diameter.
Rods BB, 3 1/2 in. long, 3/8 in. diameter.
Bar C, 3 1/2 in. long. 3/4 in. wide, 1/4 in. thick.
All four screws 1/4 in.

The transmutation of metals is still an enigma, and will doubtless remain so indefinitely. The galvanic battery has shown that alkalies have a metallic base, but it is a vexed question if a precious metal can be manufactured from substances which are believed to contain its ingredients.

A TWENTY FIVE FOOT AUXILIARY YAWL.

CARL H. CLARK.

V. Cabin Trunk and Rudder.

Before completing the cabin trunk construction it will be well to build the center-board trunk as it is much more convenient to work inside the boat before the cabin beams are put in. In Fig. 13 the outline of the centerboard logs is shown. These logs are the lower plank of the centerboard trunk and fit onto the bottom, being shaped to the proper curve. They are to be cut to the shape shown, cut of 2 in. oak plank. The upper edge is jointed straight and the lower edge is curved by trial to fit the curve of the bottom. The square notches are cut to allowit to fit over the bottom braces at the ends of the centerboard slot. The location of these centerboard logs is shown in Figs. 11 and 22. The construction of the centerboard trunk is shown in Fig. 19. A "head ledge" is fitted in between the center!-board logs and extends high enough to take the ends of the side planks. 8he head edges are of oak 2 in. x 3 1/2 in. and about 2 1/2 ft. long. The one for the forward end is straight, while that for the after end is curved to a radius of about 4 ft.

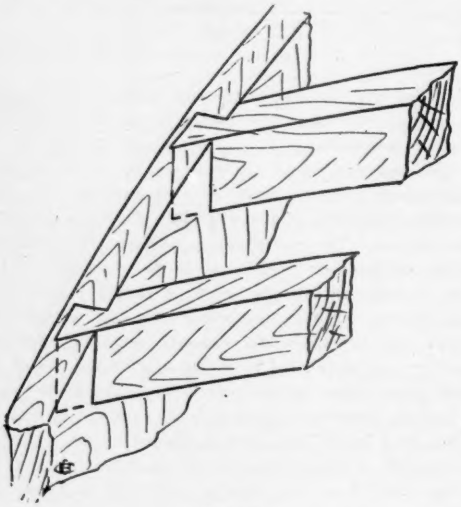


FIG. 23.

These head ledges are now et up at the ends of the slot, extending down flush with the under surface of the bottom. The centerboard logs are clamped along side of the ledges and carefully fitted. All surfaces are painted. A thread of cotton saturated with lead is laid along under each centerboard log, and also up on the side of each head ledge. The logs are now clamped tightly to the head ledges and may then be fastened down in place on the bottom. Heavy nails or screws are driven through the tapered ends of the logs into the bottom. Alongside the slot, howerer, 3/8 in. galvanized rivets should be used, headed over on both ends and spaced about 6 in. apart. A centerbore should be made for the heads of these rivets so that they will not protrude. The remainder of the side planking of the trunk may be of 7/8 in. pine, well jointed and fastened to the head ledgeswith galvanized nails, not forgetting the thread of cotton already mentioned. The top edge of the upper plank should be 2 ft. 3 in. above the bottom and should be finished level, or parallel with the water line.

Heavy nails are also driven through the logs into the ledges. Cotton calking must be driven around the sides and ends of the head ledges, working from the under side. The ends of the side plank are finished off even with the face of the ledges, and all nail heads should be 'set' down even with the surface. The top of the box is covered by a board, with rounded edges, and a slot to allow the rounded end of the centerboard to project through.

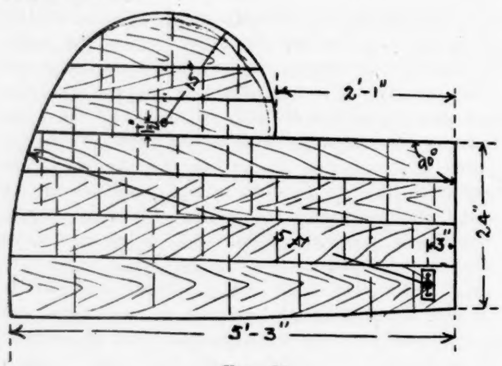


FIG. 24.

The house beams are now to be put into place. These are of oak, cut from a 3/4 in. plank, and are 1 1/2 in. deep with a crown of 6 in. in 6 1/2 feet. These beams should be neatly finished all over, and the under edges either bevelled or beaded. They are spaced 9 in. from center to center, beginning at the after end of the cabin, directly above the heavy deck beam already in place. The best way of fastening these cabin beams to the trunk is by a dovetail joint as shown in Fig. 23, not

allowing them to go entirely through the trunk side, but leaving about 3/16 in. of stock at the end of the dovetail. In this way the ends do not show on the outside. In addition to the dovetail a long nail should be driven down through the end of the beam into the trunk. The upper edge of the trunk side must now be bevelled to the slope of the beams to allow the top planking to fit smoothly.

The top plank is of pine 1/2 in. thick, tongued and grooved. It is fastened in place with 1 1/4 in. galvanized nails. It is laid and trimmed off around the edges, and the opening for the sliding hatch cut out. This opening is 30 in. wide and extends to the fourth beam, as shown in Fig. 21, making it about 27 in. long. The beams, also, are cut off. The top is now to be covered with 8 oz. duck, laid in paint, stretched tightly and tacked around the edges. If possible, this should be obtained in one piece, but if not, it should be pieced down the middle. A piece of 3/4 oak half round moulding is now bent around the upper edge of the house to cover up the tacks, and the canvas is cut off even with its lower edge.

The bulkhead of the after end of the cabin is next to be built. It is of 5/8 in. tongued and groved pine; it is fastened on the after side of the heavy deck beam and the after cabin beam, and is carried down and fastened to short pieces bent in on the plank. This bulkhead should be well fitted and fastened both to the beams above and to the plank below, as it will form a very efficient brace to prevent the boat from twisting. An opening is, of course, left of the same width as that in the cabin top. A piece of 3/4 in. oak half round at the top will cover the joint. If the heavy deck beam has not already been cut off it may now be done, leaving it just even with the opening.

The lights in the cabin trunk are each 12 in. long, forward one being 3 1/2 in. wide and the after one 4 in. The glass is rabbeted in from the outside and set in putty, and the inside corners of the opening are bevelled off.

The skeg, or deadwood, is 3 in. thick, preferably of oak. At the after end it is 16 in. deep, and it is 7 ft. long. Its lower edge is straight, while its upper edge is curved to fit the bottom. The skeg is fastened with long spikes driven from the inside, except at the extreme point, where a heavy screw is used. In driving these spikes care must be taken to keep clear of the shaft hole, the center of which is 12 in. up on the after face of the skeg. The hole for the shaft should next be bored; the exact slope will depend upon the diameter of the fly wheel of the engine, but if a point is taken 10 in. above the bottom at mould No. 5, a line from this point to the point already mentioned on the back of the skeg will give a good line. The hole should be first bored by trial, using about 1/2 in. bit; it may then be tested by sighting, or by a line stretched between the two points. It may then be increased in size, using a large bit and taking out more on one side or the other to give it the proper direction. Its final size should be about 1 1/2 in. It is advised that this hole be lined with a piece of thin lead pipe to make the joints perfectly tight. Pipe about 3/32 in. thick should be used and it should be turned on both ends, bedded in lead and tacked with copper tacks. The inside shaft log, resting on the inside of the bottom need not be fitted unless an inside stuffing box is used, which is not common. In case it is fitted, it should be bored with the same size hole as the deadwood, and the lead pipe carried all the way through.

A piece of oak plank 2 1/2 in. thick 6 in. wide and 20 in. long is now securely fastened up and down the middle of the stern board, just above the stern knee. It forms the step for the mizzen mast and also holds rudder post tube.

The rudder post tube is a piece of 1 1/4 in. galvanized iron pipe, 18 in. long, threaded up 6 in. on one end, the other end being square. The hole for this tube is bored from the outside, just at the water line. Here again it may be necessary to bore a smaller hole and trim it out with a gouge or otherwise. The tube should be carefully fitted and greased and turned down into place with a pipe wrench. It would best not be put into place permanently until the step for the mizzen mast has been cut.

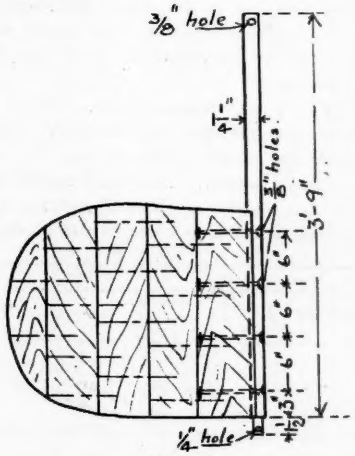


Fig. 25.

The step for the mizzen mast is a mortise about 5 in. long 1 1/2 in. wide and 2 in. deep, with its center about 6 in. aft of the center of the rudder hole. The mast hole in the deck should be directly above it and be about 3 in. diameter to be trimmed out exactly to fit the mast later.

The forward mast hole is 4 1/4 in diameter cut in the place already provided for it. The step formed of a piece of 2 1/2 in. oak plank as shown in Fig. 22 resting upon and fastened to the cross timbers of the bottom. The

mortise is 4 in .wide and is located with the help of a plumb line dropped from the center of the mast hole above.

The bitt post is 3 in. square and extending down mortising into the stem as in Fig. 22. It should extend 6 in. above the deck and be provided with a piece of 5/8 in. brass rod 9 in. long passing through it crosswise to wind the lines about .

The cabin floor is 6 in. above the bottom amidships and is supported upon blocks resting upon tne bottom stiffeners. The floor itself is of 3/4 in. pine or spruce.

The standing room floor is about 12 in. above the bottom at its forward end and is level. It is supported upon spruce beams about 2 in. deep and 7/8 in. wide, spaced at each frame and supported by cleats nailed to frames or plank. The floor boards are 3/4 in. thick of pine. The outer boards must be neatly fitted around the frames and some form of finishing strip worked in.

The after bulkhead at the end of the standing room is of 1/2 in. matched pine. A door should be left in it for access to the space and also a slot for the tiller to pass through.

In Fig. 24 is shown the centerboard. It is of 1 1/4 in oak or hard pine fastened together with 1/2 in. iron rods. The boring of these holes for the rods is not as difficult as would appear. The pieces should be about 6 in. wide, and should be clamped together one after another, bored, and the rods driven. If plenty of lead

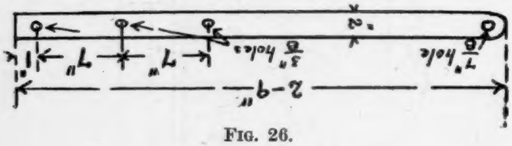


FIG. 26.

is smeared on the rods they will drive very easily. The lower and after sides should be shod with pieces of 1 in. half round iron, both to protect the board and to add to its weight so that it will sink into place. For a pivot, a rowlock socket should be fitted to take the wear. It must be put into the boat from below, the boat being heeled for that purpose. A 1/2 in. bolt is thus passed through holes in the centerboard logs to support it. If rubber washers are placed under the head and nut of this bolt no leakage can take place.

The rudder is shown in Fig. 25. It is 1 1/4 in. thick at the stock and tapers to 7/8 in. at the after edge. The first board should be of oak and be fastened to the stock by 3/8 in. rivets, headed on both ends. It should be rounded out to fit neatly around the stock. The remainder of the rudder may be of hard pine put together with 5/16 in. rod in the same manner as the centerboard. The stock is of 1 1/4 in. round rod, shouldered down to 3/4 in. at the lower end. The rudder is 2 ft. 3 in. long and 24 in. wide at the widest point.

The iron skeg is shown in Fig. 26; it is of 2 in x 1/2 in. flat bar, with holes drillled as shown. The iron work may be done at any blacksmith shop, the pipe may be gotten from a gas fitter and tne whole sent away to be galvanized.

With the addition of a 1 1/2 in. oak half round moulding around the edge of the deck plank, the carpenter work on the boat is about complete, the only work remaing being the building of the engine bed and the fitting of seats, transoms and doors, which will be taken up next.

NEW BOOKS RECEIVED.

HENLEY'S ENCYCLOPEDIA OF PRACTICAL ENGINEERING AND ALLIED TRADES. Edited by Joseph G. Horner. 6 volumes of about 500 pages each, 99 3/4 x 7 1/2 inches. Copiously illustrated. Price, per set, $25; per volume, $6. Norman W. Henley Publishing Co., New York.

It is not an easy task to properly present the merits of such an extensive work as this, as its very character prevents other than a statement of the degree of skill and knowledge used in its compilation. The ability of the editor-in-chief is ample assurance that in these respects it would be entirely satisfactory, if we accept the method of classification, and even here preferences differ. In general, each topic and subdivision of a topic is presented under its separate heading, in preference to a single division with subheads. Exception are found to this however, as under "Drills," is found "Counterbores, " while "Twist Drills" are separately treated. This is a minor matter, however, and to others than the technical reader, will not be found detrimental to the best use of the work.

It is very comprehensive in its scope and quite up-to-date, tools being mentioned which been but lately put upon the market. It is more especially devoted to mechanical subjects, althoug civil engineering subjects receive due consideration. Processes are given prominent treatment, whenever their impartance warrants it, giving the volumes a more practical character than ordinarily is the case. The illustrations are most excellent; the text and type are clear and easily readable. For public, school and shop libraries, as well as the mechanic whose means will permit of its purchase, this publication should be particularly valuable, and it deserves their extended patronage.

The sacred fires of India have not all been extinguished. The most ancient which still exists was consecrated twelve centuries ago, in commemoration of the voyage made by the Parsees when they emigrated from Persia to India. The fire is fed five times every twenty-four hours with sandal wood and other fragrant material, combined with very dry fuel.

The longest fence in theworld, it is thought, is one of wire netting in Australia, 1,236 miles long. Its object is to keep rabbits from the cultivated fields.

The world uses at least 170,000,000,000 matches yearly.

ELEMENTS OF DYNAMO DESIGN.

IRA M. CUSHING.

III. Equasion of the Dynamo—The Armature.

Before proceeding into the fundamental equation of the dynamo, the principle under which the current is generated must be studied. In 1831 Faraday discovered that if a closed conductor be moved across a field of magnetism an electric current would be generated in the conductor. By closed conductor is meant a loop or coil of wire with the ends fastened together to make a complete circuit. Faraday further discovered that an electric current so generated flowed in a direction at right angles to the direction of motion and at right angles to the lines of force.

Later Dr. Fleming worked out his graphic illustration of the rule, which is this:—Point the thumb, first, and second fingers of the right hand so that they will be approximately at right angles to each other. (See Fig. 9.) With the thumb representing the direction of motion of the conductor, the first finger representing the direction of the lines of force, the second finger will represent the conductor and will point in the direction in which the current will flow in it. In passing, it might be useful to note that the left hand will represent the motor. In this case there is given the direction of the current in the armature conductors and the direction of the lines of force, and then the thumb will give the direction of rotation of the armature. These two rules are very useful to remember and sometimes save much time.

Faraday proved, after many experiments, that the E. M. F. induced in this coil of conductors was directly proportional to the number of lines of force cut per second. From this it is readily seen, therefore, that the E. M. F. is proportional to the speed with which the conductor moves through the field of force, to the number of lines per square inch or magnetic density, and also to the length of the conductor in the magnetic field. Since the length of the conductor in the field and the magnetic density are both components of the total number of line of force, the latter term is used, which serves to simplify formulae and calculations.

The expression, "moving across a field of magnetism," has been used to explain the genetation of current in a conductor. This implies cutting of lines of force. These expressions serve best in working out a formula for the result, but the following is probably a better explanation of the action. It is evident that if a piece of wire with its ends apart is passed through a field of force no current is generated, as there is no chance for it to flow although there may be what is called a "difference of potential" between the two ends; that is, there is a tendency for current to flow. If the ends are brought together to make a closed coil, and this coil be moved in a uniform field of force (where the density is everywhere the same) in a direction at right angles to the lines of force, its axis always parallel with the lines, no current will be generated in it. If, however, the coil be moved to a denser or less dense portion of the field, or into another adjoining field where the lines go in an opposite direction, an E. M. F. will be generated. Or if the coil be turned on an axis at right angles to the

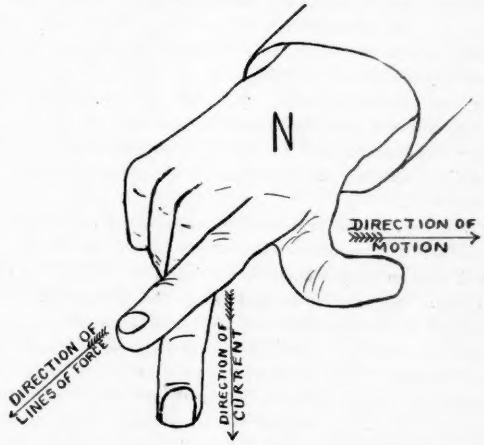


FIG. 9.

lines of force, then an E. M. F. will be induced. In the first instance the conductors of the coil were all cutting lines of force, but during all the motion the number of lines threading through the coil remained the same; for every line coming in at the front a line passed out at the back. In the other instances the number of lines threading through the coil changed as it moved, and experiment shows that the E. M. F. induced in the coil is directly proportional to the rate of change.

Fig. 10 represents a simple dynamo. W is a coil of wire centered on and rotated by shaft A-A, and placed in the field of force produced by the N and S poles. Each end of the coil is connected to a segment in the two-piece commutator C, and by means of the brushes B,B, and the external circuit D, the path for the E. M. F. generated in the coil is completed. When the coil is placed as shown with its plane at right angles to the lines of force, the maximum number of lines are threading through it.

If the coil be turned on its axis, or shaft A,-A, through an angle of 90 degrees, or until its plane is parallel with the field of force, the number of lines going through will become zero. Another turn of 90 degrees would bring the coil to the position of maximum lines again. During this half turn E. M. F. would be generated in the coil and this E. M. F. would be proportional to the rate of change of lines through the coil. This rate of change is equal to the total number of lines in the field, and the coil in turning cut the total number of lines. Therefore, when an armature is so placed in a field that the total lines can, during some portion of a revolution, thread through the coils the number of lines cut by a conductor are equal to the rate of change of lines threading through the coils. The next half turn of the coil completes one revolution and also repeats the process of generating E. M. F.

It is seen, therefore, that the E. M. F. generated is proportional to twice the total number of lines of force or 2N. If the armature is now wound with as many coils as can be put on, all coils being in series, it can be readily seen that the final E. M. F. will be proportional to the number of coils. It should also be noted that each coil has two conductors on the face of the armature. Therefore the E. M. F. is proportional to one-half the number of conductors on the face of the armature.

Further, if the armature is revolved at a greater or less speed than one revolution per second the E. M. F. will also be proportional to the speed in revolutions per second. All conditions governing the generation of a current in an armature coil have now been ascertained, and from this it is possible to make a general statement or formula. The absolute volts E (C. G. S. unit) is equal to $1/2Z \times n \times 2N$, where Z is the total number of conductors around the armature, n the revolutions per second and N the total lines of force. The 1/2 and the 2 cancel each other and the formula reads:

$$E(\text{C. G. S. units}) = nZN \qquad (11)$$

The volt of the C. G. S. system is entirely too small for practical use as it it takes 100,000,000, or 10^8 as it is designated, of them to make one practical volt as now used.

Formula 11 will therefore become

$$E(\text{practical volts}) = \frac{E(\text{C. G. S.})}{10^8} = \frac{nZN}{10^8} \qquad (12)$$

This, then, is the fundamental equation of the dynamo and is used, with a few modifications, for designing all machines. Formula 12 is correct for two pole dynamos. For more than two poles it becomes

$$E = \frac{p}{c} \times \frac{nZN}{10^8} \qquad (13)$$

in which p is the number of poles and c the number circuits in parallel in the armature from brush to brush.

Now that the equqation of the dynamo armature has been worked out, it would be well to study a little closer into what takes place in the coil as it turns in the field of force. Referring to Fig. 10, if the coil is turned 180 degrees to the right it will be found, accord-

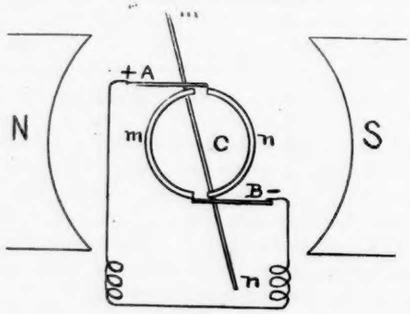


FIG. 10.

ing to Fleming's rule of thumb and fingers, that the E. M. F. will flow from n to m while that conductor is moving from top to bottom of the field. Turning the coil the rest of the way around to its original position, and applying Fleming's rule, shows that the E. M. F. flows from m to n, or just the reverse of the first half revolution. It will be readily seen from this that for the first half E. M. F. will flow out of the brush R, which is attached to the m end of the coil, and for the second half revolution will flow in at R coming out at brush T. Circuit F will then receive a pulsating or alternating E. M. F.

As alternating E. M. F. is not what is wanted, some scheme must be devised to change the direction of the E. M. F. at the same moment that it is changed in the coil. By making this double change it will be possible to obtain a continuous flow of E. M. F. The device used is a commutator, as shown at c, Fig. 10. This consists of two segments of metal, preferably copper, thoroughly insulated from each other, the entire surface being cylindrical. One end of the coil is attached to one segment and the other end of the coil to the other segment. Two brushes made of a spring metal bear on the commutator and are set so that they touch the commutator at diametrically opposite points. Now, if the brushes are set so that they slip from one segment to the other at just the time the E. M. F. changes direction in the coil, it will be found that the E. M. F. will always flow out of the top brush A in Fig. 11. It will be seen, from this figure, that the rate of change of lines in the coil will change from an increasing rate to a decreasing rate as the coil passes the vertical position. Or applying Fleming's rule, the direction of motion of the conductor changes from going up on the left to going down on the right and the change will take place as the coil passes the vertical position. The brushes A and B are, therefore, set to change from one segment to the other as the coil passes the perpendicular. As the conductor m passes down the south pole the E. M. F. generated will come towards the

observer, and as brush A is in contact with segment m, the E. M. F. will flow out from that brush through the circuit back to brush B. As conductor m continues around and moves up the north pole, Fleming's rule, will show that the E. M. F. generated will flow away

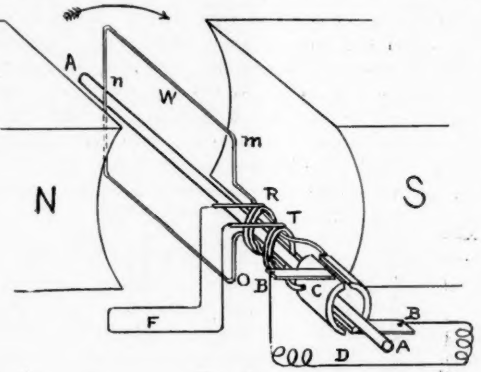


FIG. 11.

from the observer. But in the mean time A has slipped on to the segment n and B is in contact with m. Now by the same rule, n is delivering E. M. F. to brush A. It will be easily seen, therefore, that brush A will be in contact with the segment connected to the conductor moving down along the south pole and which is generating E. M. F. that flows towards the observer. Brush A is, therefore, always delivering E. M. F. to the circuit and is consequently called the positive, +, brush and B will be the negative, —, brush.

Electrical Methods of Measuring Temperatures

So much attention is now being paid to the determination of high temperatures in industrial processes where a rough guess was formerly considered good enough for practical purposes, that it is well to call attention to the two different methods of measuring temperature electrically, namely, the e.m.f. method and the resistance method. These are totally different and depend upon different properties of metallic substances. The e.m.f. method depends upon thermoelectric action. According to the electronic theory, if a certain metal, say copper, possesses a given average number of free negative corpuscles per cubic centimeter, while at the same temperature iron possesses a larger number of such free corpuscles, then, when these two metals are brought into contact the iron will tend by surplusage to diffuse free corpuscles across the mutual bounding surface at the junction, and the copper will be made negative by the reception of negative electricity, while the iron will correspondingly become positive. Since the rate of diffusion of free corpuscles increases in each metal with the temperature, so, also, will the e.m.f. of the junction. In order to have a resultant thermal e.m.f. in a closed metallic circuit, a difference of temperature is, of course, necessary between the two junctions. Conversely, by the measurement of this resultant e.m.f., the difference of temperature becomes known. The resistance method depends upon the fact that metals increase in resistivity with temperature. According to the electronic theory, the mean free path of the corpuscles in metal diminishes as the temperature rises. This has the same effect on the electric conductivity as though the length of path remain unchanged, but the number of free corpuscles diminished. But however we try to form a mental picture of the action, the fact is perfectly definite that at the standard temperature of melting ice, pure metals increase in resistivity about four-tenths of one per cent. per degree Centigrade. Moreover, the rate of increase follows a straight-line law with respect to temperature up to at least 100 degrees C. For high temperatures there appears to be a deviation from the straight-line law, in some metals at least.

An interesting paper on the measurement of temperature by electrical means was read at the Milwaukee Convention of the American Institute of Electrical Engineers by Edwin F. Northrup. The paper is addressed almost entirely to the resistance method, and suggests a number of important details in the technique of the manufacture, use and maintenance of resistance thermometers, such as go to make the difference between satisfaction and dissatisfaction in their application. In the first place, a special brand of nearly pure platinum is recommended for its uniformity and relatively high temperature coefficient. Then precautions have to be taken to prevent the platinum from dissolving or absorbing metallic vapors at high temperatures. Pure nickel wire is also recommended for moderate temperature thermometers. The beautiful principle of the Kelvin double Wheatstone bridge is also recommended for use with low-resistance thermometers. In such cases the resistance coils can be made very compact, and of dimensions comparable with those of a thermo-junction. For direct reading purposes a special form of D'Arsonval differential galvanometer, called a ratiometer, is described, in which the control is magnetic instead of elastic. That is, the coils lie flat in a dissimmetrical magnetic field, such that the differential magnetic actions cause the movable system to seek a definite magnetic displacement. The three leading-in wires are arranged to exert jointly a negligible torque about the axis of pivot rotation. Some of the results reported with the various types of instruments described constitute jointly a valuable research on temperature measurement and its automatic recording, and will prove directly useful to those responsible for the operation of plants in which it is desirable to maintain temeperatures of a uniformly high degree. The enormous waste of fuel caused by overheating, apart from defective characteristics of the products of high-temperature operations not under close thermometric control, make this subject one of much technical importance.—"The Engineering Record."

A TOOL CABINET FOR BENCH WORKERS.

WALTER SCOTT.

This tool cabinet I consider the most convenient for bench workers of any I have ever seen. It can be carried or shipped as easy as any tool chest and it is surprising the number of tools it will contain. The cabinet should be placed four or five inches above the centre of the bench and every tool will be within easy reach. It will only occupy about five inches of bench room when open.

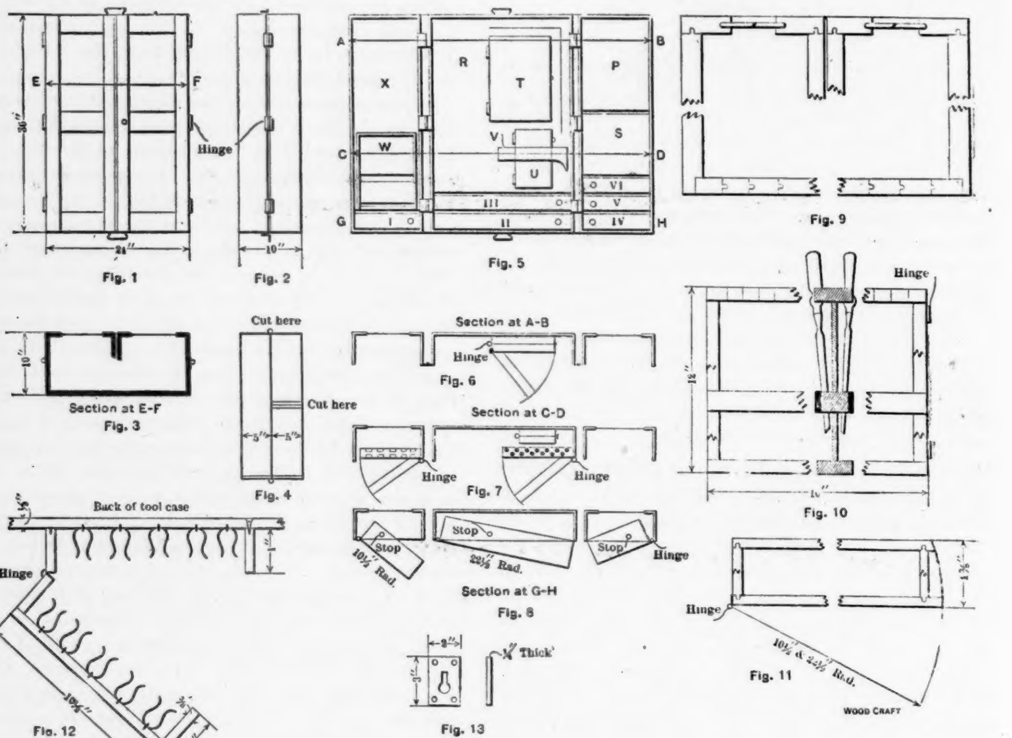


Fig. 1 Fig. 2 Fig. 3 Fig. 4 Fig. 5 Fig. 6 Fig. 7 Fig. 8 Fig. 9 Fig. 10 Fig. 11 Fig. 12 Fig. 13

One 2-inch No. 14 screw holds case to the wall, the iron plate, Fig. 13, is screwed to the back of case and three inches down from the top; the screw enters lower part of slot, case drops down and is held firmly. Fig. 1 is a front elevation of the cabinet. The case is built solid, then cut as shown in Fig. 4. Fig. 5 shows case open. The section at G H shows the tills I, I, III, IV, V and VI open or partly open. The tills have flush draw pulls in one end. A 1/2 inch dowel, 1 inch long, set in the partition between the tills, forms a stop as shown in G H.

Fig. 9 gives detail of construction. Fig. 1 is detail of chisel and straight-gouge rack. Fig. 11 detail of drawers, built of 1-4 inch stuff, and two inches deep.

The letter T designates the bent-gouge case (details are shown in Fig. 12), with springs to hold tools in place. At letter R is space for three planes placed in end, with suitable buttons to hold them. There is also room in this space for combination square, inclinometer, etc. The letter P shows the room for brace, hand drills, planes, rabbet planes, etc. At X is space for saws and long tools. The chisel rack is in place at W and is hinged to swing around so that one can get at both sides. At V is a rack for small bits, nail sets, plug cutter, and such small tools as are constantly in demand. This rack is a block of wood with holes bored part way through and is hinged to swing out of the way of the bit case at U which holds a complete set of bits. It is arranged same as the bent-gouge case, Fig. 12.

This tool cabinet should be built of hard wood, and

if well made will last a lifetime. A continuous hinge, such as piano manufacturers use, would be better than the three hinges shown in Figs. 1, 2 and 5. The left-hand door fastens with an elbow catch and the right-hand door is secured to it with a spring lock. It may seem a good deal of work and expense to make a case like this, but the convenience will make up for that in a short time. Your tools are always in place, not scattered all over the bench and in the way. When it is time to leave the shop, there are very few tools to gather up; just swing the doors shut and that is all.—"Wood Craft."

STARTING A SHOP.

After reading the articles by Entropy, Dixie and others, I thought perhaps my experience in starting my shop would be of interest. I have always read with much interest all articles that applied to small shops, because my shop is small, and naturally I would be more interested in the small shop. I would like to hear from others who have a small shop and who started, so to speak, with nothing.

My start occurred about twelve years ago when I was 18, and living on a farm. I first started in with electricity, the same as a great many boys are doing today. I kept this work up a short time, all the time I could get when I did not have to work on the farm, and that was not much, as I preferred to work in the little shop than out in the field.

I made up my mind I must have a lathe, so I begged my grandfather for one. He bought me a No. 5 1/2 Barnes foot-power lathe. When it came, in five boxes, my grandfather bet me a dollar I could not put it together, but lost his bet as I soon had it assembled and a piece of iron in, doing my first lathe work.

There being no shop in town, I soon had a number of customers come to me to get work done. I picked up quite a few dollars, which I spent for small tools. I soon bought a set of 2 horse-power upright steam-engine castings, which I finished with the exception of boring the cylinder and turning the fly-wheel and crank-shaft. It was not long before I had to have a boiler, so I went to work and built a small porcupine type of boiler.

Things ran along in this way for a little over a year. Then I wanted to move to town and start a machine shop. So I had to ask my grandfather again for a little help to get started, as I had spent what little money I had made for small tools and engine. My grandfather rented a small piece of ground near the grist mill and put up a small building 18x24 feet, bought a 21-inch Snyder drill press, a piece of shafting, a few pulleys and what belting was needed. This was my shop as started in July, 1896.

I took steam from the mill boiler and did not use my boiler except when they were not fired up. In about a year I bought a 22x22x5-foot planer. I had previously bought castings for a small emery wheel, on which to do saw gumming and other grinding, which I finished up myself. I also bought a 10-horse-power upright boiler and steam pump.

Business was good. I had one man working with me, but got crowded for room, so in the spring of 1898 I started work on a larger shop. I bought a lot and put up a two story brick building 28x50 feet with three rooms; machine room, boiler room and blacksmith shop. I also bought a 24-inch New Haven lathe, a large emery grinder and a power saw. Such is my shop at the present time.

Two years ago I took up the manufacturing of gasolene engines to fill in my spare time. I am situated in a good farming country, with no competition, the nearest shop being ten miles distant.

In regard to money matters I have had no trouble to speak of in getting money due me and have not lost over $15, which I think is doing well. I have not over $75 book accounts that I cannot get any time I go for them. While this $75 is not really good, I have not given up hopes of getting it.

Dixie's method of "50 per cent. deposit required on all work" is a good thing, but I do not think I could ask it here with success, as a large amount of work is brought in by the hired men, who are not able to pay or who do not generally have any money with them and would have to go out and borrow it, in order to pay the 50 per cent. deposnt. To those not known or customers who are slow pay, I require cash when work goes out.

I heartily agree with Dixie about buying a small steam engine and boiler. They are more bother than they are worth, for a good gasolene engine is much better and takes much less looking after. It is started in a minute and all expense stops when the engine is stopped. In a small shop the engine is not needed all the time, but when steam is used, steam has to be kept up just the same. I use steam in the winter and a gasolene engine in summer when no heat is required.

I buy for cash only, and always take advantage of a 2 per cent. discount in 10 days where possible to do so, and pay all bills when due. H. C. Davenport in "American Machinist."

Chilled iron is whiter and has a harder surface than iron cast in any other way. It is cast in metal molds called chills, where by reason of the rapid conducting of the heat, the iron cools more quickly on the surface than it would had it been cast in sand.

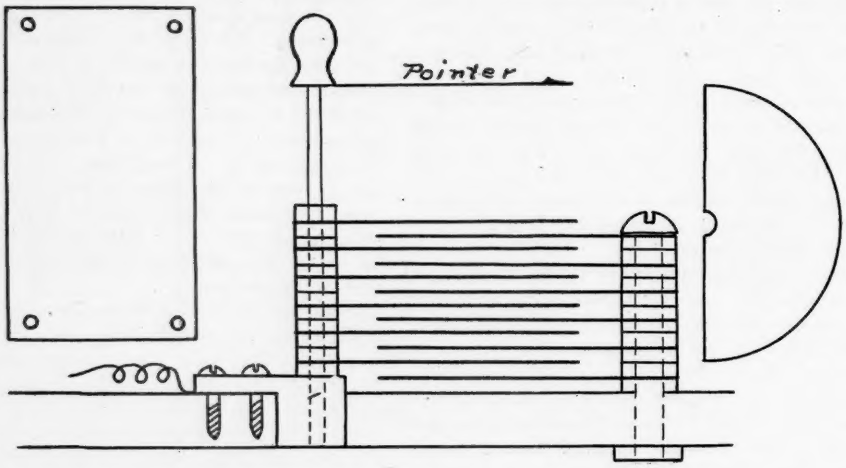
When mercury is sub-divided minutely, as in stamp-milling, it is said to "floured"; when the globules become coated with grease, fine slime, manganese oxide, etc., so that they will not coalesce, the mercury is said to be "sickened."

ADJUSTABLE CONDENSER.

OSCAR F. DAME.

During a recent visit to a large wireless telegraph station, I observed in use a special type of condenser of very simple construction, and when immersed in insulating oil, so highly efficient that immediately on my return I set about making one for my own laboratory, where it now fills a long felt want.

In wireless work the services of an adjustable condenser are invaluable, but most adjustable condensers are simply banks or sets of small condensers which may be connected in series or multiple to give a few selected capacities. With an electrolytic receiver the condenser must be adjustable by every gradual and minute steps, otherwise the sounds heard in the head telephone will be faint and uncertain. At one time a bulky type of adjustable condenser was made from two telescopic tubes of glass lined with tin-foil, the inner tube being pushed more or less into the other tube to give desired capacity. Such a decice was bungling and very liable to breakage and finally gave way to the type here described.



In constructing the condenser, first purchase some extra heavy stove tin in perfectly flat sheets. From two of these cut four pieces 10 in. long by 5 1/2 in. wide. In the four corners of these pieces holes are punched to take four 8/32 machine screws. The four screws are thrust through the holes in one piece of plate, and then iron washers of a thickness of 1/8 in. slipped onto the screws. Then another plate is placed, and another set of washers, and so on until the four plates are in place, when the nuts are turned down securely onto the screws. By this arrangement we have four plates electrically connected, but 1/8th of an inch apart.

With a pair of dividers two circles are scribed on tin plate, 8 in. in diameter, and then each circle divided in two equal parts. With a pair of tinsmith's shears, the four half-discs are cut out evenly, care being taken to not bend or warp the discs, for each disc is to slip in between the square iron sheets previously mentioned, without touching at any part. At the point which was used as a center in outlining the circles, or exactly 4 in. in from the edge, it is advisable to punch or cut a 3/16 in. hole before cutting out the discs. Then, when the cutting is completed, we have a metal piece shaped as in Fig. 1.

A longer 8/32 machine screw than those previously used is next procured, also a supply of nuts to fit same. These nuts should be as near 1/8 in. thick as possible. The discs are next mounted on this machine screw, by screwing a nut securely against each disc until 4 discs are firmly fixed in place, one above the other, and 1/8 of an inch apart. The with soder the discs, nuts and screws are firmly affixed together.

A base-board of 1/2 in. pine or white-wood 12 ins. square is next procured and carefully shellaced on both sides and the edges. Holes are bored to take the four machine screws used in constructing the square plates, and the four screws slipped through and fastened with a final nut on each. This brings the bottom plate close to the wooden base. Calculations must now be made to find the proper position of the half circular pieces in their relation to the fixed plates, for as will

probably be surmised by this time, the machine screw supporting them is to form a pivot or staff by which the half-discs are to revolve, thereby permitting the discs or vanes to intermesh as much or as little as desired, and without touching the permanent iron sheets at any point. This latter is imperative.

Having ascertained the exact position of this machine screw pivot, the head of the machine screw is cut off, and the exact diameter of the part un-cut with threads taken with calipers. With a drill of this size, a hole is bored in a block of brass or iron which is used to support the vanes erect. A hard-rubber knob is affixed to the other end by means of which the discs may be swung back and forth as desired without danger of discharging the electrcity through the body.

Having completed these metal parts, and connected two binding posts, one to the pivoting block, and the other to the fixed vanes, and having assured ourselves by actual test that the vanes swing clear of each other, we will now proceed to construct a wooden case for the condenser, which will contain parafine oil, when finished, as an insulator. This box will measure 12 in. square inside, and of a hight 1/2 in. above the highest vane. If the maker feels certain that he can construct a case with corners tight enough to hold parafine oil. a cover may also be built of proper size and a small indicating needle affixed to the pivot screw outside the cover, by which the exact location of the moving vanes may be ascertained without removing the cover. One may experience difficulty in constructing a case to hold oil, and I would advise that a second case 1 in. larger all around be built, and the first one sealed in place with plaster o fparis, which will furnish a positively secure container for the oil.

This condenser is by far the best I possess for universal use. I find it invaluable with an electrolytic receiver, and have also substituted it for Leyden jars in connection with the secondary discharge of an induction coil. The only chance for a break down is where, through over-sight, the moving discs are permitted to touch or come too close to the fixed plates.

Recent Wireless Achievements.

Some extremely successful results in the employment of wireless telegraphy have recently been recorded in the case of certain of the vessels of the North -German Lloyd Company provided with Marconi apparatus. Thus the Kaiser Wilhelm II., which has an equipment considered to be effective only for a relatively small radius, up to say two hundred miles, in order to communicate with passing ships, or with the coast, at the beginning or end of the voyage, has on several occasions lately received signals from very remote quarters. On her last voyage but one to New York, while the ship was off Texel, she was able to place herself in communication with Crookhaven, 600 miles away. She also on her homeward voyage to Bremen picked up the Nantucket Lightship at a distance of 600 miles, and later was able to speak Sable Island, distant about 800 miles. Subsequently she signalled the Cunarder Caronia, at distances of 1050 and 1200 miles, on the second occasion when that ship was off Cape Sperone, south of Corsica, with almost the whole of Europe intervening between them. It has been observed that these wide ranges are only possible when the vessel is at certain spots, either over the Newfoundland banks or off the Dutch coast, and it therefore seems to be probable that it is only in these places that atmospheric conditions highly favorable to the distant transmission of wireless signals are prevalent. A remarkable, if not an equally extreme variability in the apparent efficiency of Hertzwave apparatus has been repeatedly observed before. Rear Admiral Brownson's flagship, the West Virginia, furnished an illustration of the phenomenon when she was bringing President Roosevelt home from New Orleans a year ago last autumn. It is doubtful whether under ordinary circumstances the cruiser could send intelligible signals more than three hundred, or, at the utmost, five hundred miles. Yet while she was in the Gulf of Mexico despatches which were meant for Key West were picked up at Norfolk, Washington and even in Kansas! Though no harm resulted from the occurrence, they reached a number of ears for which they were not intended.

For some of the inequalities in the range of a particular transmitter adequate explanation have been found. One type of receiving instrument is more sensitive than another, and hence will respond at a greater distance from the source of the wave impulses. Again, the degree of resistance to the ether waves which is offered by the atmosphere varies. Sometimes an effect is produced like the obstruction to ordinary light that is presented by dust or thin fog. It appears to be independent, too, of the paralyzing influence of direct sunlight. Operators on other steamships than the Kaiser have had the opportunity to discover whether one part of the ocean is more favorable than another to wireless telegraphic communication, but they have apparently failed to observe anything of the kind. If a peculiarity like that under discussion really exists, it is queer that it was not detected years ago.

Theoretically, a miner working underground requires only 6 1/2 cubic feet of fresh air per minute for respiration, the absorption of moisture, and the dilution of carbonic aacid gas. This, however, assumes that all air after having been breathed is immediately removed, without mixing with the surrounding atmosphere, a condition impossible to fulfill.

A piece of granite measuring 60 by 30 by 14 feet has recently been quarried at South Ryegate, Vermont, establishing a record.

LOG HOLDER FOR FIREPLACE.

JAMES HUNTER.

In a residence having fireplaces in which wood is used as the fuel, the storing of a suitable supply of wood near the fireplace is attended with dirt and chips unless some receptacle is provided for the wood. An investigation at several stores of what the market afforded in the way of wood boxes did not disclose anything that met my wishes, and as the making of a simple rack did

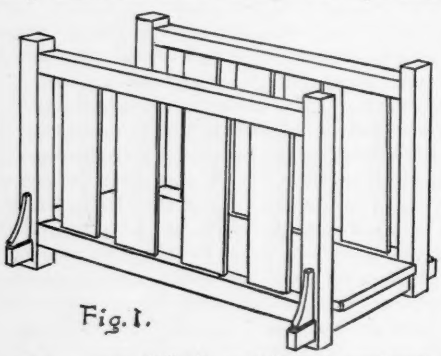


Fig. 1.

not seem a very difficult operation, I purchased the necessary wood and constructed the holder here described, which has proved entirely satisfactory for the purpose intended and has also been commended by indulgent friends. I therefore submit the following description, with the hope that the more critical audience it is now to meet will not find it unworthy of their approval.

The perspective illustration, Fig. 1, plainly shows the design, and Figs. 2 and 3 the dimensions of the several parts with a few exceptions, and these will be given in the text. Carefully selected oak was used throughout, the desire being to get pieces as finely figured as possible. The sides were made first. Eight pieces 15 in. long, and 1 3/4 in. square, and eight pieces 9 3/4 in. long, 2 in. wide and 1/2 in. thick are needed. Four of the square pieces form the corners and the other pieces run horizontally along the sides as shown in Fig. 2. Mortises are cut in these latter piecese 1/4 in. deep for the slats, and the ends are cut down to form tenons to fit in mortises cut in the corner pieces.

About the only thing to be noted in cutting the tenons and mortises in the sides and corners is the way the tenons on the lower sides and corners is the way pieces, Fig. 3, are carried by each other, those on the side pieces being cut on the upper part and on the end pieces on the lower part. The two end pieces are 16 in. long; the tenons on the ends are 4 in. long, 1 in. wide and 1 1/2 in. high. The board forming the bottom is 18 in. long, 2 in. wide and 7/8 in. thick. The corners are beveled off to avoid being marred by the logs. The inverted brackets on the tenons at the corners were cut out with a compass saw and smoothed with a spoke shave. It would save considerable work if these pieces could be cut on a band saw. They are held in place with glue. The board forming the bottom is fastened with three large screws at each end, the holes for them

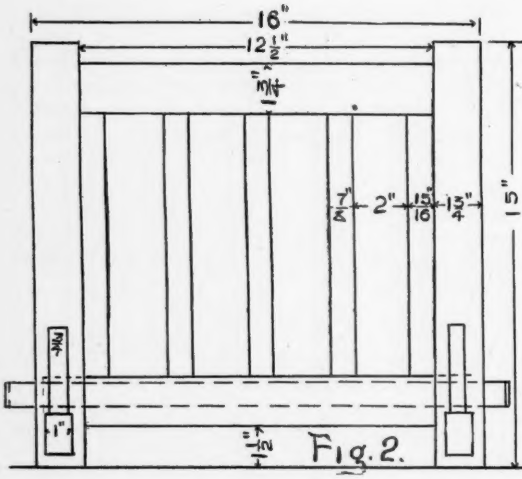


Fig. 2.

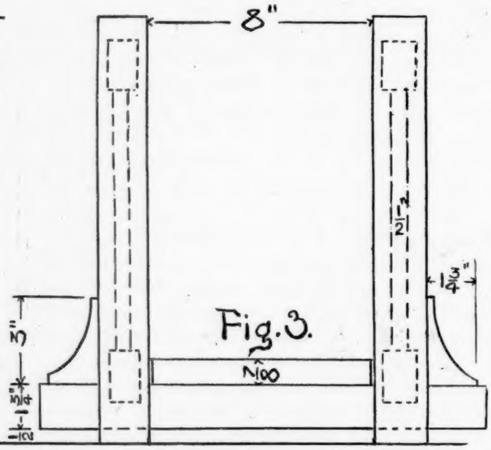


Fig. 3.

were cut with a 1/2 in. bit for about 1/4 in., then countersunk for the screw heads, and after the screws are in, covered with buttons cut out of waste pieces, with a knife and set in with glue. Any unevenness is then taken off with a sharp chisel and finished with sandpaper.

When completed, a coat of "fumed oak" stain was put on, and finished with a mixture of linseed oil, paraffine wax and turpentine, three coats of the latter being needed before the result was satisfactory. It is quite probable that many readers will see ways whereby this design and the method of construction can be much improved, but if what has here been said shall be found of any value, the writer will feel amply repaid for having submitted this too imperfect description.

VOLCANOES VENTS IN THE EARTH.

At the last meeting of the Boston Scientific Society, Professor George H. Barton spoke in a very interesting way on "Volcanoes," his paper having been called forth by the recent events in the way of eruptions and earthquakes. In outlining his subject Professor Barton called attention first to the changes which had taken place in the definition of volcano within the past wenty years and again to the latest conceptions of he sructure of the earth. "When I went to school," said the speaker, "we were taught that a volcano is a mountain that sends forth fire, smoke and lava. The latter day definition considers it not to be necessarily a mountain, nor does fire or smoke issue. A volcano, in our recent terminology is a vent in the earth's surface from which lava comes forth." The ashes which the volcano sends forth may fall about the lava and form a cone, or the lava itself may be heaped up in pyramidal form, but these mountain forms are incidents and not necessities.

Professor Barton gave in condensed form the nomenclature of the different layers of the earth, names which will be new to the generality of readers. The central portion of the earth is a hard mass about which practically nothing is known. It is believed to be firm and is of high specific gravity, higher, for example, than steel. This portion of the earth is denominated "centrosphere." Outside of the centrosphere lies the "lithosphere," the rocksphere, of which we know much and very little. The outer part of this, the ground we walk upon has been very closely studied and we know a great deal about it, and through it about the adjacent portions near the surface. But this knowledge is limited to portions of the earth at or near the surface. The "hydrosphere" is the mass of water covering a great portion of the earth's surface, the ocean, and the atmosphere is the medium in which we live. The "hydrosphere" and the atmosphere are important in geology from the effects which they have had in modifying the conditions of the surface, the water by direct erosion and the atmosphere by the more insidious processes of weathering, fracturing by heat and cold, separating by frost action, erosion by the running water and chemical actions of various kinds. For convenience the "lithosphere" is divided into two zones, the fracture zone, which is the outer part, and the flowage zone, which is the inner one. In the latter the rocks are under such enormous pressure that they become plastic and flow about into cavities as ice can be made to do at the surface. In the fracture zone the pressure is less and breaks and fissures in the rocks are important features in many of the phenomena.

Professor Barton then pictured the condition of the materials below the surface where under great heat and enormous masses of rock material exist. The igneous granites, for example, were such rock masses beneath the surface and wherever they are now found at the surface it presupposes that there formerly existed above these masses from five to ten thousand feet of earth or rock which has been removed.

Professor Barton then went on to the direct consideration of volcanoes, illustrating every point in their development and eruption by means of fine lantern views. The steam clouds of Vesuvius at its recent eruption, driven by the enormous force into the air for a hundred miles or more, and similar clouds on Pelee were particularly striking. The speaker's own experience with volcanoes had been in the Hawaiian Islands, which show different types, containing among others the largest crater on the earth, which while not comparable with those of the moon, still has a diameter of more than thirty miles and a depth of two thousand five hundred feet. All of the varied phenomena, the eruption, the flowing lava, the lava sprouts of fiery red, molten lava, of which he has seen at one time more than a score, the roughness of the lava bed, the smoothness of its satin-like finish, the cinder cone, all were noted and explained.

A POCKET WIRELESS OUTFIT.

An English electrical engineer, Mr. Ernest Oldenburg, has recently invented a new telegraphic receiver which, it is claimed, is sensitive enough to detect the most delicate impulses which a pocket battery, such as might be concealed about the person, could send out. This instrument, which is at present known as the "capilliform" receiver, is "more sensitive that the brain"; it is said to transcend previous inventions as far as Lord Kelvin's siphon recorder, which alone made submarine telegraphy practicable, surpassed its predecessors in delicacy. It depends on the fact that mercury in a vertical capillary tube—like that of a thermometer—rises and falls when an electric current is passed through it. This fact—which would be more accurately expressed by saying that the surface tension of the mercury, and therefore the shape of its meniscus, changes under the influence of an electric current—has long been known. Mr. Oldenbourg's invention consists in magnifying it

and in utilizing it in a shape which enables it to be used practically as the receiving instrument of a telegraphic installation. Its peculiar value is, it is claimed, that it will respond to far smaller currents than those at present used; a mere fraction of a volt is sufficient to work it. Mr. Oldenbourg holds that it will be quite possible, with the aid of his new instrument, to make a telegraphic apparatus by which any one walking about the floor could send intelligible messages for instance to a confederate on the platform, where a "mind-reading" act is being performed, without any one else knowing about them.

SCIENCE AND INDUSTRY.

There are mining engineers who are paid $25,000 annual salary, and that is not considered the limit, as some distinguished members of the professions are credited with receiving more than that. Such a salary is by no means an unusual one among railway men, some of whom receive $50,000 a year. As to whether any man can make himself worth that amount of money to any concern per year, it may be said that while no one might "earn" that amount in the ordinary acceptation of the term, yet where a man by knowledge, experience and judgment can save or make, say a million a year, to the company he represents, 5 per cent of that would represent his salary, and there are many broad gauge engineers, miners and railway men capable of such showing.

For the purpose of obtaining a hard combustible, well adapted for use under boilers, an electric process recently adopted in Engand, says "The Iron Age," requires two and one-half hours and yields a material of high calorific value, almost smokeless, and less expensive than ordinary coal. The basis is peat, which is placed in revolving cylinders, and the water (originally 80 per cent.) is largely driven off. A set of electrodes in the cylinder uses the mass of peat as a part of the circuit. The passage of the current warms and dries the peat, but without carbonizinz it, and pulverizes it for the next stage in the process: The peat is then treated by a kneading roller and placed under an automatic press, which forms it into briquettes. It is then stored for final drying.

Green Lake, Col., is not only noted as the highest lake in the United tSates, being 10,252 feet above the level of the sea, but also for tne fact that its water has a peculiar faculty for petrifying substances that are placed in it. The water of Medicine Lake, in the southern part of the tSate of Washington, on the Columbia plateau, possesses such unusual qualities that no vegetation ever grows on or near its banks. Owen's Lake in Owen County, Cal., is so rich in soda ash that 10,000 tons were taken out last year. The soda is taken fro mthe water by the process of evaporation. Tis lake, like the Great Salt Lake, is gradually disappearing.

The highest bridge in the world will be the trolley-bridge now under construction across the famous Royal Gorge, in Colorado, which will be 2,627 feet, half a mile, above the river below. As far as height goes, this little bridge—only 230 feet long—will be in a class by itself, its nearest competitor being the recently completea Zambesi bridge, in Africa, 450 feet in height.

In Arkansas there is a prehistoric quarry from which flint for making tools and weapons was produced on so large a scale that in certain places the hills and mountains have been practically remodeled by the pitings and trenchings. It is estimated that fully 150,000 cubic yards of flint have been removed from the hillside. Similar prehistoric quarries are known in other states and in the Indian Territory.

When a dynamo is to be operated by a separate engine not on the same bed-plate, the foundation should be made common to both, or if separate foundations are necessary, set the two machines on a frame made of substantial timbers, or steel I-beams, which may rest on the double foundation. In this manner the engine and dynamo may be kept in perfect alignment.

The distillation of coal tar is ordinarily done by heating in steel vessels inclosed in brick work settings, provided with grates for burning coal. The vapors thrown off are condensed in coiled pipe or worm immersed in water. The distillates flow into a small receiving tank that empties into storage tanks, the oil being separated in accordance with its specific gravity. The remaining pitch is then transferred from still to cooler, then flows into barrels when cooled to proper temperature. Stills commonly used are horizontally placed cylinders of boiler plate. The large ones hold about 10,000 gallons.

In Birmingham, England, a device has been invented that will light street lamps by clockwork. The invention is so nicely adjusted that the gas will be lighted at a different moment each day in the year, according to the varying seasons. The machine turns on the gas at night and lights it, and turns it off in the morning. When once adjusted it will run for a whole year by simply winding the clockwork attachment once a week.

The density of the earth as a whole has been estimated, with close agreement among the several scientists who have made the determination by different methods, to be about five and one-half times as heavy as an equivalent sphere of water. On the other hand, the average density of the materials forming the accessible portions of the earth's crust is between 2.2 and 3, so that the mean density of the whole globe is about twice that of its outer part. This indicates that the central part of the earth is composed of heavier materials and may even be metallic, which would accord perfectly with the nebular hypothesis.